This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

ABSTRACT OF RESULTS

OF A STUDY OF THE GENERA

GEOMYS AND THOMOMYS:

WITH ADDENDA ON THE OSTEOLOGY OF

GEOMYIDÆ,

AND ON

THE HABITS OF GEOMYS TUZA,

BY DR. ELLIOTT COUES, U. S. ARMY.

[SEPARATELY REPRINTED FROM THE REPORT OF MAJ. J. W. POWELL'S EXPLORATION OF THE COLORADO RIVER OF THE WEST AND ITS TRIBUTARIES. EXPLORED IN 1869, 1870, 1871, AND 1872, UNDER THE DIRECTION OF THE SECRETARY OF THE SMITHSONIAN INSTITUTION. CHAP. XIII, PP. 215 ET SEQQ.]

BIBLIOTHECA BODLEIANA

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1875.

189. k. 113

PART THIRD.

ZOOLOGY.

By ELLIOTT COUES.

CHAPTER XIII.

ABSTRACT OF RESULTS OF A STUDY OF THE GENERA GEOMYS AND THOMOMYS.*

By Dr. Elliott Coues, U. S. A.

These two genera are closely allied; the principal difference being in the character of the sulcation of the superior incisors. In *Geomys*, the upper front teeth have a deep groove along the front face, at or near the middle, with or without a fine groove along the inner margin. In *Thomomys*, the latter groove exists, but there is no other. The fore feet of *Geomys* are more decidedly fossorial than those of *Thomomys*, owing to greater development of the claws. In *Geomys*, the external ears are a mere rim surrounding the auditory orifice; in *Thomomys*, there is a decided, though small, auricle. The two genera constitute a perfectly natural group, of the grade of a family, which may be called *Geomyidæ*, equivalent to the subfamily *Geomyinæ* of Baird, or the *Sciuro-spalacoides* of Brandt. Their closest affinities are with the *Saccomyidæ* (*Dipodomys*, *Perognathus*, &c.), under which they have been placed as subfamilies by Waterhouse and Baird. These authors are certainly right in differing from those who, like Brandt and others, widely dissociate the two groups; for, as Baird has insisted, they are very closely allied in all essential respects, notwithstanding their remarkable dissimilarity in contour and other superficial points. Still, I do not go to the length of the authors named in associating *Geomys* and *Thomomys* with *Dipodomys*, *Perognathus*, &c., in one; preferring to follow Gill in considering them as a distinct, though the most nearly allied, family. The *Saccomyidæ* are extremely lithe, agile, graceful animals; jerboa-like, with long saltatorial hind limbs, elongated and often tufted tail, large ears, and full eyes, and are not specially nocturnal or subterranean in habits. The *Geomyidæ*, on the other hand, are hamster-like, or rather an exaggeration of that kind of structure; they are among the heaviest for their inches of any animals of this country, of squat, bunchy shape, with short, thick limbs, a short tail, very small or rudimentary ears, small eyes, no appreciable neck, and thick, blunt head; and they are as completely subterranean as the mole itself. They are rarely and only momentarily seen above ground; they excavate endless galleries in the earth in their search for food, frequently coming to the surface to throw out the earth in heaps, but plugging up these orifices as soon as they have served their purpose.

---

* Based on the material contained in the National Museum, Smithsonian Institution, Washington, D. C.

Both families agree in possessing enormous cheek-pouches, overlying the whole side of the head, in some species even reaching over the neck and shoulders. The nature and construction of these sacs was long misunderstood. They were supposed for many years to be external pendulous bags opening into the mouth, and thus to differ only in degree of development from the ordinary "cheek-pouches" of many other rodents—an enlargement of the mucous membrane of the mouth and skin of the cheeks. But, as now well known, they have no connection with the mouth; at least, no more than the abdominal pocket of an opossum has with the genitalia. Their chief purpose is not even related to the food of the species; they are sacs that the animals use chiefly in carrying out dirt from their burrows to deposit it on the surface of the ground. They are fully described beyond.

Several circumstances have conspired to obscure the history of the *Geomyidæ*, and to involve the determination of the species in doubt. In the first place, the animals are largely withdrawn from ordinary observation, and the acquisition of specimens is difficult. Their geographical distribution is limited to a portion of America. Very few specimens, comparatively, have ever reached Europe, and very few foreign naturalists have written about them from anything like sufficient means of observation. In fact, they are among the rarest sets of specimens in any museums; and I think it probable that there are before me, as I write, more prepared specimens than have before been examined by all naturalists put together. This shows the difficulty of getting material to work upon on this family, though the animals fairly swarm in certain regions, becoming a serious hinderance to agriculture. There is another point to be considered here: the shapelessness of the species, so to speak, with the looseness and distensibility of the skin, renders them peculiarly susceptible of atrocious taxidermy, with the result of scarcely leaving a hint of their actual appearance and true dimensions. One result of all this is that a mass of pointless, if not erroneous, descriptions and conflicting accounts forms a large part of the written history of the species. There appears to have been an unusually large amount of compilation done in this group; more than half of everything extant upon the subject is of this character.* The ' systematic" accounts given by Fischer, Schinz, Wagner, Giebel, and some others that might be named, are simply worthless for any practical purpose. The special papers upon the subject are so few that it was not thought necessary to enumerate them. Aside from the descriptions of "new species" which it is necessary to examine, the authorities which need be consulted are very few. Waterhouse's and Brandt's articles; especially Richardson's, in the Fauna Boreali-Americana; LeConte's monographic sketch of the family; and Baird's later, more elaborate, memoir, with Audubon's and Bachman's figures, represent the gist of the matter. The synonymy collated in this paper is believed to represent very nearly all the literature of the subject.

It is not within the scope of the present article to treat fully of the characters of the family. I confine myself here almost entirely to the determination of the species and their full description, with the necessary bibliographical matter. The number of species I find to have been, much as usual, largely overstated. This is particularly the case in the genus *Thomomys*, where the three recognizable races of the single known species have been described as a dozen distinct species, and been referred to half as many different genera. Most late authors recognize at least six or eight species of the genus. *Geomys* makes out a better case; out of the seven species admitted by Baird, five are unquestionably valid. It is very curious and interesting to note how differently *Geomys* and *Thomomys* have become differentiated into species. The former genus has developed into at least five perfectly well-discriminated species, the early links between which have entirely disappeared, leaving the forms as stable as possible. *Thomomys* is still in a transition-stage at present. Setting aside the peculiar *T. clusius*, described as new beyond, all the known forms of that genus are still only incompletely separated, and the links binding them are plainly before our eyes. The genus appears to be making into a number of species, but the process is still far from completion. In talking over this singular difference in the natural history of these two closely-allied genera with Professor Baird, he threw out a suggestion, which, perhaps, may account for the facts. While we have no means of knowing which is the older of the two genera, so as to compare the rates of progress they respectively made in developing their species, yet we may fairly infer, upon geographical considerations, that *Geomys* has been longer about it than *Thomomys*. *Geomys*, though found to a certain longitude westward, is essentially a form of Eastern North America, extended thence to Central America, and it is presumably upon older ground than the late deposits in the West, where *Thomomys* occurs. In the cases of many mammals and birds of this continent, it will be recollected there is a perfectly stable eastern species of a genus which in the West is represented by a number of "varieties." *Junco*, *Melospiza*, *Passerella*, *Picus*, are good illustrations. But be the explanation what it may, there is no doubt about the fact that *Geomys* has made itself into five or six firm species before *Thomomys* has succeeded in turning out more than one or two.

---

* *Cf.* the synonymy of *Thomomys talpoides et aff.* in the following pages.

With these few observations by way of introducing the species, I shall proceed at once to give an account of them, reserving many details which contributed to the result of my investigation, as well as all general considerations respecting the family, for publication in a different connection.

GENUS GEOMYS. (*emend. ex* Raf.)

Mus, *sp.* SHAW, *et al.*, *l. c. infra.*
Cricetus, *sp.* DESM., *et al.*, *l. c. infra.*
Geomys, RAF., Am. Month. Mag. ii, 1817, 45.
Diplostoma, RAF., *op. et loc. cit.* (char. plerumq: inept.), *nec* RICH.
Saccophorus, KUHL, Beitr. 1820, 65.
Pseudostoma, SAY, Long's Exp. R. Mts. i, 1823, 406.
Ascomys, LICHT., Abhand. Berl. Acad. 1822–'3, 1825, 20.

GEOMYS BURSARIUS, (Shaw) Rich.

Mus bursarius, Shaw, Linn. Trans. v, 1800, 227, fig. 8; Gen. Zool. ii, 1801, 100, pl. 138 (the plate clearly shows the grooved incisors; the pouches are everted).—Mitc., Am. Journ. Sci. iv, 1822, 183.

Cricetus bursarius, Desm., Nouv. Dict. d'Hist. Nat. xiv, ——, 177; Ency. Méth. Suppl. pl. 10, f. 4; Mamm. ii, 1822, p. 312 (*bursareus*).—F. Cuv., Dict. Sc. Nat. xx, ——, 257.—Desmoul., Dict. Class. viii, ——, 37.—Griff., Anim. Kingd. iii, 1827, 138, pl. —; v, 1827, 235, No. 612.

Saccophorus bursarius, Kuhl, Beiträge, 1820, 65.—Fisch., Synop. 1827, 304.

Pseudostoma bursarius, Say, Long's Exp. R. Mts. i, 1823, 406 (*bursaria*).—Harlan, Fn. Amer. 1825, 153.—Less., Man. 1827, 259.—Godman, Am. Nat. Hist. ii, 1831, 90 (*bursarium*).—DeKay, N. Y. Fn. i, 1842, 92.—Aud. & Bach., Q. N. A. i, 1849, 332, pl. 44.

Geomys? bursarius, Rich., F. B. A. i, 1829, 203; Rep. Brit. Assoc. for 1836, v, 1837, 156 (*nec* Gray).

Ascomys bursarius, Eyd. & Gerv., Voy. Favorite, v, 1839, 23.—Schinz, Syn. ii, 1845, 132.—Gieb., Odontog. 53, pl. 23, f. 8.

Geomys bursarius, Woodh., Zuñi and Col. R. 1853, 50.—Parvin, Ann. Rep. Smiths. Inst. for 1854, 1855, 293 (habits).—Kenn., Trans. Illinois Agric. Soc. for 1853-'4, 1855, 580.—Bd., M. N. A. 1857, 372, pl. 22, fig. 1 *a-h*, and pl. 50, fig. 2 *a-g*.—Maxim., Arch. Naturg. 1861, ——; Verz. Reise N.-Am. Säug. 1862, 147.—Gerr., Cat. Bones Br. Mus. 1862, 223.—Leidy, Proc. Acad. Nat. Sci. Phila. 1867, 97 (skull from loess of Missouri).—Ames, Bull. Acad. Minnesota, i, 1874, 70.

Geomys (*Saccophorus*) *bursarius*, Giebel, Säug. 1855, 529.

"? *Mus ludovicianus*, Ord, Guthrie's Geog. 2d Am. ed. ii, 1815, 292. (Not determinable.)"

? *Diplostoma fusca*, Raf., Am. Month. Mag. ii, 1817, 44.—Desm., Mamm. ii, 1822, 315.—Less., Man. 1827, 261.

? *Diplostoma alba*, Raf., Am. Month. Mag. ii, 1817, 44 (albino).—Desm., Mamm. ii, 1822, 315.—Less., Man. 1827, 261.

Saccophorus? albus, Fisch., Synop. 1827, 305.

? *Geomys cinereus*, Raf., Am. Month. Mag. ii, 1817, 45.

Mus saccatus, Mitch., N. Y. Med. Repos. xxi, 1821, 249.

Ascomys canadensis, Licht., Abh. Acad. Wiss. Berl. 1823, 13, fig.—Brants, Muizen, 1827, 24.—Wagn., Suppl. Schreb. iii, 1843, 383; Abh. K. Baier. Akad. Münch. xxii, 1846, 327, fig. (skeleton).

Geomys canadensis, Lec., Proc. Acad. Nat. Sci. Phila. vi, 1852, 158.

Geomys oregonensis, Lec., Proc. Acad. Nat. Sci. Phila. vi, 1852, 160 (no probability that the assigned locality is correct).

Geomys breviceps, Bd., Proc. Acad. Nat. Sci. Phila. 1855, 334; M. N. A. 1857, 378, pl. 52, f. 2 *a-g*.—Gerr. Cat. Bones Br. Mus. 1862, 223.

Canada Rat, Shaw, *ll. cc.*

Canada Pouched Rat, Richardson, *l. c.*—Aud. & Bach., *l. c.*

Hamster du Canada, Desm., *l. c.*

Pseudostome à bourse, Less., *l. c.*

Diplostome brun, *D. blanche*, Desm., Less., *ll. cc.*

Canadian Hamster, Griffith, *l. c.*

Goffer, *Taschenmaus*, Schinz, *l. c.*

Pouched Rat, *Sand Rat*, *Camas Rat*, *Pocket Gopher*, *Salamander*, Vulg.

Gaufre, French (whence English "gopher," and German "goffer").

Quid Geomys drummondii, Rich., Rep. Brit. Assoc. v, 1837, 157 (*Ascomys drummondii* apud Wagn., Suppl. Schreb.), species indet. dentibus prim. bisulcatis?

Diagnosis.—Superior incisors bisulcate, with a fine sharp groove along the inner margin, and another much larger bisecting the remaining plane surface. Cheek-pouches ample, extending to the shoulders. Hands (including claws) longer than feet. Tail and feet hairy. Pelage soft, sleek, mole-like. Color dull reddish-brown, muddy-gray or hoary beneath, the basal portion of the fur plumbeous throughout; or blackish-gray; feet and tail, for the most part, white or colorless. Average dimensions of adult, 7 to 8 inches; tail, 2 or 3 inches; fore foot, about 1½ inches; hind foot, about 1¼ inches; longest fore claw, about 0.75 inch.

HABITAT.—Valley of the Mississippi and its tributaries in a broad sense, and somewhat beyond to the northward. "Canada." "Oregon" (???).

DESCRIPTION.—I shall draw up my account of this species from the large amount of material, both dry and alcoholic, before me. The specimens are from the whole immediate valley of the Mississippi, from the State of that name to Minnesota; also, from Texas; from the Platte, Washita, and Niobrara Rivers, &c.; but not from west of the Rocky Mountains, where the genus has yet to be satisfactorily determined to occur. Descriptions of form and proportions are taken from alcoholic specimens in the flesh; of color, from dried specimens. The present being taken as the standard of comparison for other species, succeeding descriptions of the rest may consequently be abridged to present in stronger light their own peculiar characters. The present account, besides being descriptive of the particular species, is rendered supplementary to the characters of the genus.

The "pocket-gopher" is about the size of a house-rat (*Mus decumanus*), but less in linear dimensions and much more stoutly built, with a heavy, lumpy body, on which the skin slips loosely; no appreciable neck; a rapidly narrowed blunt head; small eyes; no obvious external ears; short limbs; strong fore feet, somewhat like those of a mole, with enormous claws; and a short, thick, stumpy tail, issuing from a conical prolongation of the rump. The side of the body, before the shoulder, is occupied by an enormous sac, opening by a wide slit along the side of the jaws, but not directly communicating with the mouth. These sacs, fully distended, represent the greatest crosswise dimension of the animal. To sum the generalities, the gopher is a mole-like rat, *plus* these great bags. The general habits bear out the simile: of all rodents, the gopher is probably the most completely fossorial and subterranean; and its underground operations are conducted with the aid of these sacs.

The head is short, wide, deep, and blunt; not separated from the body by any appreciable constriction of the neck. The frontal region is broad and flat; the sides rapidly converge; the under side and mouth parts are anomalous in their peculiar configuration. The muffle is entirely hairy, excepting a small, definitely naked nose-pad, somewhat T-shaped, with long arms and a short leg; the nostrils opening obliquely between these. There is a considerable hairy interval between this pad and the incisors, and a fringe of long hairs hangs down over these teeth. The upper incisors appear to be situated remote from the mouth; for beneath them is a long strip of finely furry skin, longitudinally vaulted, with sides sloping upward to a median line, like the roof of a house with its ridge. This great space, near an inch long, bounded on either side by the swollen furry ridges which constitute the external lips, leads to the contracted orifice of the mouth proper, or that part of the buccal cavity lined by mucous membrane, to which the parts just described are merely the vestibule. The mucous membrane only comes to the border of the thick external lips in a small patch on each side. The lip laps loosely around the base of the under incisors, and the opposite sides meet behind the teeth. In fact, the curious conformation is such that the mouth actually shuts sideways by approach and meeting of the thick lips from either side; further closure of the jaws resulting in merely a folding back of the thus apposed lips. When the mouth is closed, the incisor teeth are entirely shut out of the buccal cavity, and surrounded behind, as well as elsewhere, by furry integument; in a large specimen, with the tips of the incisors in apposition, the end of one's finger may be passed behind them, yet not into the mouth at all. On wrenching open the jaws, the fleshy tongue is seen largely filling the remarkably contracted true orifice of the mouth; but so constricted is the opening that the molar dentition can scarcely be brought into this view. This particular condition of the parts is probably not met with outside the present family.

The pouches of this species—at first supposed to be pendulous bags hanging from the mouth, then with some correction found to be not pendulous, yet believed to open into the mouth from within—are wholly external, and have no more connection with the buccal cavity than the belly-pouch of a kangaroo or opossum has to do with the genital organs. These sacs are simply a purse-shaped duplicature of the loose skin of the side of the head and neck. The free margin of the pouch arises from the side of the upper jaw, about half-way from nose to eye, just underneath the whisker-patch, and curves loosely around the side of the head to the angle of the jaw. The general outline of the orifice is semicircular (or rather semipyriform, since the broadest part sags down a little); the inner border being the proper integument of the side of the head. The lining of the sac is ordinary integument, of rather more delicate texture; it is clothed with fine fur. On the side next the head, the ordinary fur of the parts makes directly into the pouch; on the outside, the fine fur continues to the brim, where it is met by the ordinary external pelage. Between the two layers of skin rests a thin bed of muscular fibers (perhaps a modified platysma myoides), serving for such contractile movements as the receptacle may be susceptible of. But the connection between the folds of skin is so slight and loose that the pouch may, with little force, be turned completely inside out, though it does not appear that this ever occurs in life. A full-sized pouch will admit three fingers as far as the first joint.

The small eyes are situated midway between the nose and ears, below the line between these two; and, if anything, they are rather nearer the latter than the former. The ears have been described in varying terms, leaving a doubt whether there was an auricle or not; but it is proper to say that the auricle is obsolete. The large circular orifice of the meatus externus is surrounded by a raised brim, rather thicker, if not higher, behind than before, and, as such, constituting a rudimentary pinna; but there is nothing to be called a flap (which is something that may be *turned over*).

The large, strong, and eminently fossorial fore feet recall those of the mole in some respects, though they occupy the usual position with reference to the axis of the limb—sole downward instead of tilted over. The hand itself is shorter than the hind foot; but the immense claws reverse the proportion of the two as a whole. The palm is broader than the sole, and perfectly naked. At the juncture with the wrist, it presents two great movable callous tubercles, which probably have a bearing upon the great force of flexion of the member; otherwise the palm is flat, devoid of special pads or callosities, and may be thrown into indeterminate rugæ or sulci, according to the movements of the parts. There are five digits, whose relative lengths are nearly the same as those of the claws they respectively bear. All the claws, excepting the first one, are longer than their respective digits; they are much compressed, single-edged underneath, curved, and acute. Their tips are regularly graduated in position with decreasing disparity from 3d to 1st; 3d–4th–2d–5th–1st; the 3d being much the largest, the 1st a mere stump. The back of the hand is clothed with rather bristly hairs, which fall as a fringe over the sides of the hand, and of the individual digits as well.

As usual in cases of excessive growths of any kind, these great claws of the hand vary a good deal in size and shape, according to the age and vigor of the animal—in other words, according to the degree of use to which they are put. The hind foot is not remarkable, having an ordinary murine character. The sole is perfectly naked, like the palm, and devoid of special pads or tubercles; the skin being everywhere smooth. The toes are short; the claws still shorter, weak, excavated underneath (like a badger's), little curved, and rather acute. The 3d is longest; then come 2d–4th–1st–5th; the digit of the latter being a mere stump, and that of the 1st too short to carry the tip of its claw opposite the base of the 4th.

The tail has an unfinished, or rather neglected, appearance, as if it were of no particular use. It is remarkable, however, for appearing to spring from a peculiar conical backward prolongation of rump, so that it is difficult to determine its true base. This enlarged basal portion is clothed like the rest of the body. From its apex, the tail continues with a shorter and more scanty furring. The tail is rather thick (in comparison with allied rodents) and somewhat quadrangular, the flattening of the under side being especially noticeable; it tapers gradually to an obtuse tip. It is perhaps rather unusually variable in length, averaging in its scant-haired portion about one-third of the length of head and body.

The conical prolongation of the body above mentioned is that portion which protrudes beyond the ischia, which may be plainly felt on either side; and on its under side appear the orifices of the digestive and genito-urinary systems, in close juxtaposition, and both directly at the base of the tail proper. In the rutting-season, however, the topography of the parts is changed, owing to the great distention of the perinæum from the turgid organs within. In the female, there are three pairs of teats—two inguinal, near together along the inside of the thighs; and another pair, pectoral, at a considerable distance. I have not been able to discover any more; and as the same number and position have been found to hold in *G. tuza, mexicanus*, and *hispidus*, such is probably the normal case in this genus; though in species of *Thomomys* I have distinctly recognized six pairs.

The character of the incisor dentition remains for special notice, as a diagnostic feature of the species among all its congeners. Two grooves upon each upper incisor always persist distinctly. One of these is a sharp, fine line of impression, running along the inner margin of the tooth, about the distance of its own width from the edge. The other is a much larger, more profound, and wider sulcus, which fairly bisects the remaining surface, leaving an equal plane area on either side, exclusive of the small portion cut off by the fine marginal groove. This main groove varies a good deal in depth and width in different specimens, and, moreover, is itself sometimes sulcate; that is to say, this excavation sometimes presents, on the outer side, a fine ridge, which marks off a secondary groove within the first. The same thing occurs in the single-grooved species—*castanops, mexicanus*, and *hispidus*. But this supplementary carination of the main groove is not always perceptible, and is generally liable to be overlooked, it is so fine. When most strongly marked, it is just like the inner marginal groove itself; and each tooth seems to consist of two similar halves.

Coloration.—Throughout this family, the coloration is general and diffused; there are no strong special areas of parti-coloration. Most of the species (if not all) of both *Geomys* and *Thomomys* occur under two states of pelage, which we may call the chestnut and the plumbago. The difference is much like that between the gray or cinereous states of young *Hesperomys, Neotoma*, &c., and the brighter-colored adults of the same. But, in the present case, it does not appear to be a matter of age, since full-sized, if not mature, specimens are plumbago-colored. If the dark style of pelage be not wholly fortuitous—*i. e.*, pure melanism—it is, at any rate, as yet unexplained. To these generalities of coloration, it is to be added, that there is a tendency to indefinite albinism of the tail, feet, and parts about the mouth. Whatever the phase of coloration may be, the character of the pelage is constant. As in all the other species, excepting *G. hispidus*, the fur is remarkably soft, fine, and lustrous, reminding one of that of the mole; yet not of the short, close, velvetypilous character seen in that animal, but long and fluffy. The coat appears to be shed from before backward by a steadily progressing process, as witnessed by the definite lines of demarcation frequently observed.

The plumbeous basal portions of the hairs, uniform to the very roots all over the body, are of such extent, and the colored terminal parts so short to correspond, that more or less of this color appears on all but the most daintily prepared specimens, and plumbeous is the prevailing tone of the under parts. The normal coloration is a dull reddish-brown, or impure chestnut, of varying intensity, frequently with a still duller muddy-brown superficial cast difficult to describe. This is the character of the upper parts, where a dusky dorsal area may or may not be appreciable. It gives way on the sides to the plumbeous of the under parts, which is overlaid with a hoary-brown or muddy-gray. The lips, chin, feet, and even legs, and the tail, are usually more or less white, the extent and purity of this white being wholly indeterminate; it is sometimes wanting; sometimes the tail is variegated with white and brown. There are also liable to be irregular white patches on the belly. The soles and palms, when not soiled by adventitious substances, are nearly colorless. The incisors, as usual, are orange-faced in the adult state. The claws are of an indefinite pale-brown color, often variegated with extravasated blood.

The plumbago state, in which some specimens as large as any others are found, is entirely different, and does not appear to shade into the normal phase. Here the color is exactly that of a lead-pencil mark on white paper; but such is the gloss of the fur that violet, purplish, or even brassy reflections are shown with different lights. It is an intensification of the ordinary plumbeous basal portion of the hairs, and its extent over the whole fur. In this condition, white paws and tail, and other irregular patches of albinism, also occur. The plumbeous is seen in its purity only above; below, the fur is pointed with muddy-brown or gray.

HISTORY.—Although its written history does not date so far back as the early notices of the "Tucan" (*G. mexicanus*), this species was the first to be introduced to notice under a scientific name, and with a (supposed) scientific description. Dr. George Shaw was the physician who attended at the birth of the species, which he called *Mus bursarius*, giving a recognizable description indeed, but accompanying it with a grotesque figure from a drawing by Major Davies, representing an amorphous creature with a pair of great skinny, veiny bags hanging loosely from the mouth; the pouches of his specimen having everted, and this being their supposed natural state. The original figure in the Linnæan Transactions is somewhat improved upon in the General Zoology, but is still a very ludicrous object. The animal is said to have come from "Canada," where it was taken by some Indians in 1798, and afterward presented to Governor Prescott's wife. According to the description, the animal was in the plumbago state of pelage. There is no doubt whatever about the species (though some writers have refused to recognize it); even the wretched figure in the General Zoology shows the grooved incisors clearly. Moreover, this identical specimen, which once formed part of the Bullock collection in London, and subsequently passed into the hands of Temminck, seems to have been examined both by Kuhl and Lichtenstein; and, at about the same time, each of these naturalists made a new genus for its special benefit, Kuhl calling it *Saccophorus bursarius*, after Shaw, and Lichtenstein renaming it *Ascomys canadensis*. This title prevailed with most German authors. Contemporary French authorities considered it a Hamster, and referred it to *Cricetus*. Say established, in 1823, the genus *Pseudostoma*, generally accepted by American writers.

The original mistake (arising from faulty taxidermy, that prolific source of error with the dermatomaniacs) of supposing the pouches were pendulous sacs opening into the mouth was scotched several times before it was finally killed. Meanwhile, before Kuhl, Lichtenstein, and Say had severally made their new genera, species of the genus had already entered the peculiar field of vision, or supposed vision, of M. Rafinesque, who furnished two new names. The *Diplostoma* of this writer is diagnosticated by an expression few terms of which are founded in fact; for he denies the animal tail, ears, and open eyes, and only credits it with four toes to each foot, whereas it has a tail, ears, open eyes, and five digits before and behind. In the same place, Rafinesque establishes another genus, *Geomys*, which is based upon fair characters, though there is nothing in them to prove whether he had a *Thomomys* or a true *Geomys* in view. The primary reference is, however, to Mitchell's "Hamster of Georgia" (*G. pinetis*), which fixes the matter. Rafinesque gives a number of species of each of his two genera. Twelve years subsequently, in 1829, Dr. Richardson discussed Rafinesque's names, coming to the erroneous conclusion that they both represented good genera, in one of which the cheek-pouches opened into the mouth, these being wholly external in the other. He describes several new species of *Thomomys* under the name of *Geomys*, supposing them to all have pendulous pouches; gives the present as *Geomys? bursarius;* and refers one *Thomomys* to *Diplostoma*, having satisfied himself of the true state of the case in this instance.

The *Mus ludovicianus* of Ord (1815) is a name which may be supposed to refer to this species, but it is probably not determinable, and in any event is antedated. Dr. Mitchill named the species *Mus saccatus* in 1821. The only late synonyms I have met with are *oregonensis* of LeConte and *breviceps* of Baird. LeConte, indeed, in his excellent sketch of the family, which placed the group upon a far more satisfactory footing than that it had previously occupied, calls it *Geomys canadensis;* but this is merely the restoration of Rafinesque's generic name, coupled with Lichtenstein's specific one, upon the presumption that the faulty *Mus bursarius* of Shaw ought not to be recognized. Dr. LeConte's *oregonensis* is founded upon an animal said to be from Oregon; but this locality is doubtless erroneous, for, as now well known, Townsend collected all the way from the Missouri westward, though his specimens fell in the way of being marked "Columbia River," or "Oregon," with little regard for actual localities where procured. The name *oregonensis*, besides being geographically erroneous in all probability (no *Geomys* is known to occur west of the Rocky Mountains), rests upon characters not in the least incompatible with the now known *G. bursarius*. The types of *G. breviceps* now before me are all smaller than average *bursarius*, but within the range of variation of that species; and I fail to substantiate any tangible characters by which this supposed species may be held to be distinct.

The English name of "gopher," applied to this and other species of the family, is evidently a corruption of the French term "gaufre," given by Canadian *voyageurs*. It re-appears in German as *Goffer*. In the West, where the *Spermophili* are universally called gophers by hunters and settlers, the species of this family are distinguished as "pocket-gophers." The application of the word "salamander" is not so obvious. The German equivalent of "pouched rat" is *Taschenmaus.*

Measurements.

Current number.	Locality.	Sex.	From tip of nose to—				Tail to end of vertebræ.	Length of—		Longest fore claw.	Nature of specimen.
			Eye.	Ear.	Occiput.	Tail.		Fore foot.	Hind foot.		
......	Niobrara River	♂	0.85	1.40	1.90	6.75	2.50	1.50	1.25	0.70	Alcoholic.
7327	Kansas	♂	0.95	1.65	2.00	6.50	3.00	1.50	1.35	0.70	Alcoholic.
1384	Iowa	♂	1.12	1.70	......	......	2.15	1.55	1.30	0.68	Alcoholic.
357	Saint Louis, Mo	♂	......	......	......	8.00	3.00	1.60	1.35	0.55	Fresh.
2635	Saint Louis, Mo	......	1.05	1.75	2.20	7.00	2.75	1.50	1.35	0.65	Alcoholic.
2636	Saint Louis, Mo	......	1.20	1.85	2.60	7.50	3.35	1.55	1.35	0.70	Alcoholic.
2633	Illinois	......	1.00	1.45	1.90	5.75	2.65	1.50	1.15	0.65	Alcoholic.
2539	Iowa	......	1.25	2.10	2.33	8.90	3.30	......	1.45	0.80	Fresh.
1775	Vermilion River	......	0.75	1.75	2.25	8.00	......	1.75	1.25	0.75	Fresh.
2630*	Louisiana	......	0.90	1.45	......	......	1.75	1.20	1.05	0.55	Alcoholic.

*A type of *breviceps.*

GEOMYS TUZA, (Ord.) Coues.

Hamster of Georgia, MITCHILL, N. Y. Med. Repos. v, 1802, 89; Bewick's Quad. 1st Am. ed. 1804, 525 (mentioned also by Anderson, Meare, Say, Barton, &c.)

Mus tuza, ORD, Guthrie's Geog. 2d Am. ed. ii, 1815, 292. (Based on Mitchill's animal.)

Geomys pinetis, RAF., Am. Month. Mag. ii, 1817, 45 (Georgia).—BRANTS, Muizen, 1827, 173.—DESM., Mamm. ii, 1822, 314 (note).—LESS., Man. 1827, 260.—BAIRD, M. N. A. 1857, 380, pl. 22, fig. 3 *a–e.*—GESNER, Ann. Rep. Smiths. Inst. for 1860, 1861, 431 (habits).

Saccophorus? pineti, FISCHER, Syn. 1829, 305.

Geomys pineti, LEC., Proc. Acad. Nat. Sci. Phila. vi, 1852, 159.—ALLEN, Bull. Mus. Comp. Zool. ii, 1871, 178.

Pseudostoma floridana, AUD. & BACH., Q. N. A. iii, 1853, 242, pl. 150, f. 1.

Southern Pouched Rat, AUD. & BACH.

Geomys des pins, DESM., LESS., *ll. cc.*

Gopher; Salamander, VULG.

DIAGNOSIS.—Superior incisors with a main groove dividing the tooth into two unequal portions; the outer obviously the smaller; the inner, larger moiety marked by an extremely fine marginal groove, faint, obscure, or perhaps sometimes obsolete. Tail and hind feet in adult life naked, or nearly so. Otherwise like *G. bursarius.*

HABITAT.—Georgia, Florida, and Alabama.

Description (numerous specimens from the above localities, including some mentioned by Audubon, those described by Baird, and various others, dry and alcoholic).—This species, apparently distinct, nevertheless resembles *G. bursarius* so closely, that no general points of difference in size, shape, or color can be adduced for their separation. There are, however, certain tangible characters, not necessarily the same as those given by authors. For instance, Audubon and Bachman dwell upon certain supposed differences in the structure of the pouch; but their observations rest upon bad taxidermy, and have no foundation in nature, the pouches in the two species being identical. These authors and some others speak of the upper incisors as single-grooved. This, if so, would be a strong feature: but it, unfortunately, is not the case; for, in all the numerous specimens I have examined, the upper incisors are double-grooved, as in *G. bursarius*, the fine second groove being perceptible as a delicate line of impression running along the inner margin of the tooth. It is perfectly distiut, as a rule; and in no case have I failed to recognize clearly at least a trace of it, though in some instances it is faint, and liable to be overlooked if not closely examined. Baird says that this groove is obsolete in old age, implying that such is the rule: but, while not doubting that such may occur, I must consider it as the exception; for, as just said, I have never yet failed to recognize at least a trace of it. *G. tuza*, therefore, has double-grooved incisors, like *G. bursarius;* the point of dental discrepancy lies elsewhere. In *bursarius*, the main groove bisects what is left of the face of the tooth, after subtracting the portion cut off by the inner groove; and this latter is always distinct. In *G. tuza*, the main groove divides what is left of the face of the tooth, after subtracting the portion cut off by the inner groove, into two unequal portions, whereof the exterior is the smaller; and the inner groove, always slight, may be faint, obscure, or perhaps sometimes obsolete. This is the whole case, as far as the incisors are concerned.

The only other character of *G. tuza* I can appreciate is the nakedness of the tail and feet—especially the former. It is true that in *G. bursarius* the nakedness of these parts is sometimes noticeable; but it seems to be not carried, except perhaps in extreme cases, to the extent witnessed, as a rule, in *G. tuza.* The latter thus corresponds with *G. hispidus* in this respect, though very different in other features. In the best-marked cases, the tail is perfectly naked beyond the enlarged hairy base; the skin may be stuffed out to the caliber of a stout goose-quill, and has then a peculiar bladdery appearance; if the vertebræ be left in, it shrinks tightly around them in drying, displaying not only the joints, but also the shape of the individual bones. The hind feet share this nakedness, but not to the same extent; the instep is nearly bare, but the toes are sparsely pilous with short colorless bristles. The back of the fore feet is in much the same condition. The depilation of the members is not always as complete as here described; but such is the unmistakable tendency in all cases, and such the accomplished result in the majority of examples in adult life. Younger specimens, in the plumbago state of pelage, show as hairy tail and feet as an average sample of *G. bursarius*, and before the incisors have attained maturity, so as to afford fair characters, might readily be supposed to be *G. bursarius*, were locality not taken into account. Of such character is No. 1500, Museum of the Smithsonian Institution, particularly mentioned by Baird, *op. cit.*, p. 382.

My material is abundant for a table of measurements of this species; but it seems unnecessary to prepare one, since it would be simply an amplification of the statement that the animal does not differ at all from *G. bursarius* in size or shape. For the same reason, it is unnecessary to enter into further description after presenting the two characters (particular style of sulcation of incisors and nakedness of tail and feet) in which solely does the species stand apart from *G. bursarius*.

Under these circumstances, it might be held by some that the present is merely a localized race of *G. bursarius;* and I should be the last one to dispute such statement of an abstract fact. This *Geomys* is, of course, an offshoot of the *bursarius* stock; and, for that matter, so are all the rest of the "species" modified descendants of some one stock. It would be only shifting the question a peg to require that the fact should affect the nomenclature. A "permanent variety" is a contradiction in terms. This is the case: Here is a set of individuals differing thus-and-thus (as above described) from another set. The difference is slight, but constant; there is no intergradation, for the simple reason that the two sets of animals now occupy different geographical areas, are completely isolated from each other, and thus cut off from interbreeding; or, in other words, from reproducing offspring in which the characters of both parents are blended. It is quite possible that, in their blind movements under the ground, the two may come together and interbreed;

but we must wait for this to occur, and be attested by intergrading specimens, before we need hesitate to describe *G. tuza* as a "distinct species."

The earliest notice specially referable here appears to be the unmistakable description by S. L. Mitchill of the "Hamster of Georgia," and various allusions are made by other writers to the same animal. The *Mus tuza** of Ord unquestionably belongs here, being based upon Mitchill's animal. A short though expressive diagnosis is given by Rafinesque, with unwonted accuracy, of *Geomys pinetis*. This name, or its emended form *G. pineti*, has been generally applied, excepting by Audubon and Bachman, who, ignoring Rafinesque, rename the animal *floridana*, and refer it to Say's genus *Pseudostoma*. The species puts in the customary second-hand appearance under the supervision of several systematic compilers, few, if any, of whom appear to have had much knowledge of their own upon the subject.

The geographical distribution of the species is remarkably limited. I have no knowledge of its occurrence anywhere excepting in Georgia, Florida, and Alabama. The Savannah River is said to form a complete barrier to its northward extension. Its westward limit is not so precisely defined; but it does not appear to reach to the Mississippi, where the other species is found.

Audubon and Bachman have nothing particular to say of the habits of this species in comparison with *G. bursarius*, beyond the statement that it does not become dormant in winter. The best account of its habits, and particularly of its mode of constructing its underground galleries, is Dr. Gesner's article above quoted.

GEOMYS CASTANOPS, (Bd.) Lec.

Pseudostoma castanops, BAIRD, Stansbury's Rep. Great Salt Lake, 1852, 313.—AUD. & BACH., Q. N. A. iii, 1854, 304.

Geomys castanops, LEC., Proc. Acad. Nat. Sci. Phila. 1852, 163.—BAIRD, M. N. A. 1857, 381.—BAIRD, P. R. R. Rep. x, 1859, Gunnison and Beckwith's Route, Mamm. 8, pl. 10, f. 2.

Geomys clarkii, BAIRD, Proc. Acad. Nat. Sci. Phila. 1855, 332.—BAIRD, M. N. A. 1857, 383, pl. 50, figs. 1*a*–*g*.—KENNERLY, P. R. R. Rep. x, 1859, Whipple's Route, Mamm. 13.—BAIRD, U. S. Mex. Bound. Survey, ii, pt. ii, 1859, Mamm. p. —, —.—GERR., Cat. Bones Br. Mus. 1862, 222.

Chestnut-faced, and *Pecos Gopher*, BAIRD, *ll. cc.*

DIAGNOSIS.—Superior incisors with a single median groove bisecting the face exactly. Fore feet shorter, or not longer than hind feet; these and the tail sparsely pilous. Color pale yellowish-brown above, inclining more or less to dull chestnut about the head; whitish below. Size of *G. bursarius*, or rather less. Fur soft, as usual in the genus.

---

* Evidently the same word as *tuça*, *tuza*, *tucan*, &c.

HABITAT.—Texas and New Mexico.

Description (from Baird's types of *G. castanops* and *G. clarkii*, and other specimens).—This remarkable species is immediately distinguished from all others known to me by the combination of a single median groove of the incisors, pale light color, and small size. In the first-named particular alone, it agrees with *G. mexicanus;* in both these species, the single groove is central, bisecting the surface, so that, viewed from the front, there appear to be four incisors. This at once and permanently separates it from *G. bursarius*, with which it is to be compared in other respects. In size, the five specimens before me average about the same as *G. bursarius*, though none are as large as the largest of the latter I have seen. The length of the full-grown animal may be about 8 inches, rather less than more; and some are not much over 6 inches. The tail, as well as can be judged, is 2½ to 3 inches. A notable peculiarity of form, in comparison with *G. bursarius*, lies in the relative proportions of the fore and hind feet, which are much as in *GG. mexicanus* and *hispidus;* the palm, with the length of claws included, being shorter, or, at most no longer, than the sole and claws; the latter measuring about 1⅓ inches, the former only about 1¼ inches. The fore claws are, however, well developed proportionally, no difference in this respect from *G. bursarius* being readily appreciable. The external ears may fairly be called obsolete; in neither of the specimens can I make out anything more than a thickened rim surrounding the orifice of the meatus. The hairiness of the tail and hind feet is pretty much as in an average specimen of *G. bursarius* or *G. mexicanus;* they are thinly clothed indeed, but noticeably more so than is ever the case with *G. tuza* or *G. hispidus.* The pouches are somewhat less ample, apparently, than in *G. bursarius*—a character coördinated in this genus with weaker fore feet, and seen also in *G. mexicanus* and *G. hispidus.*

The coloration merits particular attention, not only as it is the next to the strongest character of the species, but because a casual phase of it was the basis of the original *Pseudostoma castanops.* It might seem surprising, and certainly it would be contrary to analogy, that a single species of this uniformly-colored family should exhibit "sharply-defined" or "symmetrically-subcircular" areas of color; and such proves *not* to be the case. The type of *Pseudostoma castanops*, now before me, in a good state of preservation, notwithstanding the vicissitudes of thirty years of museum existence, though bleached by long exposure to the light, still shows the curious chestnut head-patches, sharply defined against pale tawny-white surroundings, just as described at length by Professor Baird. But the animal was shedding its coat when killed; hence the appearance. The new fur is brightly colored, contrasting with the old faded and worn pelage.* One of the types of "*clarkii*" has the same color of the head, but this is also diffused with somewhat diminished intensity over the whole upper parts. Other specimens are entirely similar, with various shading of the main color. This may be described as a dull, pale chestnut, or almost fawn-color, more or less shaded with the plumbeous basal portions of the fur, which usually show more or less in this genus, be the fur never so smoothly laid. This tawny or fulvous tone of color is highly characteristic in comparison with the deeper and warmer chocolate or muddy browns which *G. bursarius* shows. On the under parts, though the plumbeous basal portion of the fur shows considerably, the general tint is whitish—quite white in comparison with the muddy gray of the same parts of *G. bursarius*. The whiskers are mostly colorless; they are fine and numerous, the longest about equaling the head. The claws are pale horn-color; the naked palms and soles show various discoloration, perhaps according to the quality of the soil worked in. The incisors are orange, as usual.

The few specimens of this species known to naturalists were procured in Texas and New Mexico. The animal would appear to be comparatively rare, as very few individuals, additional to those described by Professor Baird, have ever been collected, though we have plenty of the *Thomomys* (*umbrinus*) of the same region. The written history of the species is brief and precise; determination of the identity of *clarkii* with *castanops* leaves nothing to be said on the score of synonymy. *Castanops* is to be retained as the prior name, and is unobjectionable, though it has proven not particularly pertinent.

---

* Various specimens of *Geomys* and *Thomomys*, changing pelage, show curious sharp wandering lines where the old and new fur fail to meet and fit exactly; and such lines are often observed when the pelage appears to be all of an age.

GEOMYS MEXICANUS, (Licht.) Lec.

Ascomys mexicanus, LICHT., Abhand. K. Acad. Wiss. Berl. 1827, 113.—BRANTS, Muizen, 1827, 27.—WAGN., Suppl. Schreb. iii, 1843, 384; iv, pl. 206 A.—CHARLESW., P. Z. S. ix, 1841, 60.—SCHINZ, Synop. ii, 1845, 133.
Saccophorus mexicanus, FISCH., Synop. 1829, 305.—EYD. & GERV., Guérin Mag. vi, 1836, 23, pl. 21, f. 5, 6; Voy. Favorite, v, 1839, 23, pl. 8, f. 5, 6.—RICH., Rep. Brit. Assoc. vi, 1836, 156.—GRAY, List Mamm. Br. Mus. 1843, 150.—GERR., Cat. Bones Br. Mus. 1862, 223.
Pseudostoma (*Geomys*) *mexicana*, AUD. & BACH., Q. N. A. iii, 1854, 309.
Geomys mexicanus, LEC., Proc. Acad. Nat. Sci. Phila. 1852, 160.—BAIRD, M. N. A. 1857, 387.
Geomys (*Saccophorus*) *mexicanus*, GIEB., Säug. 1855, 529.
Tucan of HERNANDEZ.—*Tuça* or *Tuza*, MEXICAN.—*Tugan* apud GERR., *l. c.*
Mexicanische Taschenmaus, GERMAN.

DIAGNOSIS.—Superior incisors bisected by a single median furrow (as in *G. castanops*, which is very different in color). Coloration and general appearance of *G. bursarius* (which has two distinct grooves on the upper incisors). Fur soft, sleek, as in other species of the genus (excepting *G. hispidus*, where it is extremely coarse and harsh). Averaging much larger than any United States species (nearly equaling *G. hispidus*), with proportionally smaller pouches and hands, and weaker claws (these parts being as in *G. hispidus*). Tail and feet clothed (as usual in the genus), not naked as in *G. hispidus* and *G. tuza*.

HABITAT.—Mexico.

Description (No. 3523, Xalapa, *De Oca*, skin).—The general appearance of this animal is so exactly that of an overgrown or overstuffed specimen of ordinary *bursarius*, that I should be at a loss for terms referring to color to precisely characterize it. It is, nevertheless, entirely distinct from this or any other species. It shares, with *G. castanops*, the *single median** furrow of the upper incisors, and some other points of form; but it is much larger, and altogether of a different color. The excellently well-prepared and not overstuffed specimen here described is only equaled in a large series of *G. bursarius* by a single much overstuffed example. The dimensions cannot be given with entire accuracy; but the species probably averages, when full-

---

***G. hispidus* has been described as having a single median furrow; the emphasis here, however, is upon "single," in antithesis to the double furrow of *G. bursarius*, without reference to *exact* position. *G. tuza* is said to have a "single" furrow; but the proper implication is merely obsoleteness of the fine inner second furrow usually seen. In *G. mexicanus*, as in *G. castanops*, the furrow is truly *single* and *median*; in *G. hispidus*, single and internal; in *G. tuza*, apparently single and external.

grown, about 10 inches from nose to root of tail. Tail about 3 inches from its apparent base (LeConte gives its length as 5 inches); sole, somewhat cramped, apparently 1.50; hand, much cramped, estimated to be about the same, or rather less. Nose to eye about 1.35. Girth of body 8 or 9 inches. The pouches, as well as can be judged from the skin, are smaller proportionally than those of the United States species; in this respect, being like those of *G. hispidus.* These two Mexican species further agree in the relative smallness of the hands and less enormous development of the claws; the fore member being shorter, or, at most, not longer, than the hinder one. The vesture of the feet and tail is much the same in extent as in *bursarius,* and thus in striking contrast to those parts in either *G. tuza* or *G. hispidus.* The orifice of the external ear presents, in the dried state, a mere rim, around which no flap can be fairly recognized.

It seems preferable thus to describe this species in comparative terms to bring out the curious interrelations of the animal—a species with the size and single incisor-furrow of *G. hispidus,* yet the furrow different in position, and the pelage altogether different. Agreeing in the points of character of pelage, its color, and amount of hairiness of tail and feet with *G. bursarius,* yet at once distinguished by its superior size and single median furrow of the upper front teeth; exactly like *G. castanops* in this last respect, and in most others, yet entirely of a different color; disagreeing with all the United States species in its smaller pouches and weaker hands, and in these points agreeing with its very distinct Mexican congener.

As regards color: LeConte's animal, "which agrees with Lichtenstein's and Wagner's descriptions," and is called "*saturate cinereus, suprà nigro-tinctus, naso brunneo,*" was evidently an example of the "plumbago"-colored variation, which may occur in any species of this genus as well as in *Thomomys.* The specimen before me is of the normal coloration; and this cannot readily be characterized as anything decidedly different from ordinary *bursarius,* though there is a purity of the chestnut-brown which contrasts with the muddy brown (in some cases almost a glaucous shade or "bloom") commonly seen in *bursarius.* All the fur is deep plumbeous basally, pointed with the warm brown on the upper parts, and only partially hidden below by muddy gray and hoary ends of the hairs. There is a darkness about the auricular region. The hind feet and tail are mostly whitish (as is always liable to be the case in *Geomys*). There is some whitishness about the lower jaw, and a small white abdominal and anal patch; these last being of the irregular indeterminate character often seen in and out of this genus. This specimen corresponds exactly with Brants's diagnosis of his var. *β.* of *mexicanus*—"*castaneus, infra canescens, maculis auricularibus duabus nigro-fuscis.*" The same author's var. *γ.* suggests *hispidus;* but it is as well not to strain a point here; for injudicious scrutiny of some of the printed matter extant upon the subject of *mexicanus* might raise synonymatic difficulty with *hispidus.*

Owing to insufficiency of material, I am not prepared to pursue the subject of the characters of *mexicanus* into the details of variation in size and color; but I have no doubt that it corresponds with *G. bursarius* in these respects.

The specimen shows three pairs of mammæ—two of which are inguinal and close together along the inside of the thigh, the third being pectoral, at a considerable distance; I can find none between.

This animal is supposed to be the Tucan of Hernandez, with much probability; and, if so, it was the first of the genus to appear in print. It does not appear, however, to have received a scientific designation, or to have properly entered upon record until many years after "*Mus bursarius*" had become known, when, in 1827, it was called *Ascomys mexicanus* by Lichtenstein. I have met with no specific synonyms, though it has been referred to various genera. As the Tuza or Tuça of the Mexicans, it is treated at some length in the inedited MSS. of Dr. Berlandier, who, after a good description, says that it was supposed by Mocinno and Sessé (ined.) to be the *Mus citillus* of Linnæus, and that it is the *Taupe mexicaine* of which Clavigero speaks. "It is destructive in the fields by riddling the ground . . . . it brings up earth in its pouches, and empties them with its fore feet;" and he adds that it inhabits the cold and temperate regions of New Spain, and that he never saw the Tuza in places where there were squirrels. It is not to be inferred that its habits are in any wise different from those of *G. bursarius.*

GEOMYS HISPIDUS, Lec.

Saccophorus quachil, Gray, P. Z. S. xi, 1843, 79, ex Coban, Vera Paz, *descr. nulla!*—Gerr., Cat. Bones Br. Mus. 1862, 223.
Geomys hispidus, Lec., Proc. Acad. Nat. Sci. Phila. 1852, 158.—Baird, M. N. A. 1857, 386, pl. 22, f. 4 *a–d*.
Pseudostoma (*Geomys*) *hispidum*, Aud. & Bach., Q. N. A. iii, 1854, 306.

Diagnosis.—Superior incisors with a single strong deep furrow, lying wholly in the inner half of the tooth. Tail and hind feet naked, or nearly so; fore feet sparsely hirsute. Fore feet, including claws, decidedly shorter than the hind feet. Pouches moderate, scarcely or not reaching beyond the head. Pelage stiff, hispid, and almost lusterless. Color uniform dull chocolate-brown, merely paler, grayer, or smoky brown below. Of large size; upward of a foot long; tail short, about 3 inches; sole, 1⅝, &c.

Habitat.—Mexico and Central America.

Description (from various dried specimens).—The animal indicated in the foregoing paragraph, and about to be described in further detail, agrees perfectly with the accounts given by LeConte and Baird from the same specimen collected some years ago by Mr. Charles Pease, somewhere between Vera Cruz and Mexico City. The type remained unique until recently, when several well-prepared skins reached the Smithsonian. These are from Xalapa, Mexico (*De Oca*), and Necostla, Mexico (*Sumichrast*); Costa Rica (*Zeledon* and *Carmiol*); and Guatemala City (*Van Patten*). Most of these specimens are labeled "mexicanus," as might have been expected under the circumstances. They agree perfectly with each other, as well as with the above-quoted descriptions, and are unquestionably distinct from the true *mexicanus*.

In the original notices, the character of the upper incisors was not fully indicated, owing to defect of the specimens. My specimens show that these teeth are unisulcate, as in *mexicanus*, but that the position of the groove is sufficiently different to constitute by itself a perfect specific character. In *mexicanus*, as has been already said, a single profound groove bisects the tooth; in *hispidus*, there is a similar single groove, but it lies on the inner half of the tooth. In some specimens, indeed, where the groove is widest, it may encroach slightly upon the median line; but it usually lies altogether to one side, the outer plane surface of the tooth being alone as wide as the groove *plus* the inner plane surface. This character is unique among the species described in this paper. The teeth of old animals are also of immense size, suggesting a beaver or porcupine; the under incisors sometimes protrude nearly an inch, while the upper ones are exposed for over half an inch.

The next most notable feature is the nakedness of the tail and feet. The tail, in extreme cases, is absolutely bare—not a hair or bristle can be discerned, even on holding the specimen up to the light, except upon the enlarged base In these cases, the hind feet, from the tarso-metatarsal joint outward, are nearly bare, though a few bristly hairs may be observed, especially on the toes. The hands share the same nakedness, but in less degree; their backs are sparsely clothed with bristly hairs, indeed, but not in sufficient quantity to conceal the skin; a slight stiff fringe of hairs overhangs the inner border. Specimens vary in these respects; in some, delicate bristles, scarcely visible except when held up to a light, are scattered over the tail, and more evident ones clothe the instep. But the parts are never fairly hairy, as in *mexicanus*, always presenting a peculiar skinny appearance.

There are additional characters, aside from size and color. The very short tail is less than one-fourth as long as the head and body. Owing, in part, to a less development of the fore claws, the hands are not as long as the feet. The longest third claw before me is only exserted three-fourths of an inch, and it is usually shorter than this. The second and fourth claws are subequal to each other. The whole hand is smaller and weaker than in the *G. bursarius* group, indicating less fossorial nature; and coincidently with this—perhaps in correspondence with it—the cheek-pouches are not so highly developed. As well as can be judged from prepared skins, the sacs do not reach beyond the head—certainly not to the shoulder; their capacity, in an individual nearly a foot long, seems no greater than that of specimens of *G. bursarius* eight inches long, and not more than half as bulky.

The hispid pelage is a remarkable feature; this is so strong a character that the species may readily be diagnosticated in the dark by the "feel" of the fur, and it is instantly noted in comparison with any of the other species, in which the pelage is sleek and soft, much like a mole's. Besides being so coarse and harsh, and almost entirely lusterless, it is longer than usual, and interspersed with still longer and almost bristly hairs. There is no perceptible under-fur different from the general pelage; and the color is uniform to the roots of the hairs. The whiskers are numerous, but short; the longest not equaling the head. There are other lengthened bristles over the eyes, on the cheeks, and elsewhere; but they are not readily discovered amidst the coarse hispid hair of the parts.

There is no occasion to enlarge upon general characters of the muffle, feet, &c., shared by other species. In the best-prepared specimens, the large orifice of the external ear is seen to be nearly surrounded by a small but unmistakable flap.

It is characteristic of all the other species of *Geomys* I know of, those with soft hair, to have plumbeous-colored fur at base, pointed with the particular brown, fulvous, or other shade which determines their appearance to the eye. The case is different with *G. hispidus*, in which the pelage is unicolor from base to tip; and the color, too, is peculiar. It is a dark mahogany-brown, or rather a chocolate, or *café sans lait* color, a little lighter or darker according to age or season, or fortuitously, but in any event uniform over all the upper parts and sides. Underneath the color is the same, but paler and dilute—like *café au lait;* sometimes quite smoky gray, or muddy brown. The under parts, however, frequently show patches of white here and there; these are altogether indeterminate, being as irregular in size, shape, number, and position as the similar white patches on the under side of a mink (*Putorius vison*). It is probable, also, that plumbago-colored individuals occur, as happens to the other species; but I have seen none such. The naked parts appear to have been reddish or flesh-colored; the claws are an indefinite horn-color; the incisors are faced with the usual rodent-red; color of eyes not stated on labels, but probably black.

The size of the species can only be approximately estimated from the dried skins; but it is evidently the largest species of those here treated, somewhat exceeding *G. mexicanus.* Well-prepared skins average about 11 inches in length, with a girth of some 9 inches. The tail, from the extreme base, is less than 3 inches; its naked part hardly over 2. Sole of foot about 1¾; palm, including longest claw, less than this. Nose to eye, nearly 1½. A ruler inserted in the pouch measures off about 2½ inches from the bottom of the sac to the snout. The opening of the sac is about 1½ inches long.

In a female, killed during lactation apparently, I find, after diligent search, only three pairs of teats—two pairs inguinal, and one pair, *longo intervallo*, pectoral. These are very conspicuous, on naked scabrous spaces, and the thin coarse fur would hardly, I think, hide others if they were present. In some species of this family I have distinctly recognized *six* pairs. I observe no sexual peculiarities in size or color.

The geographical distribution of the species has been already indicated as far as my present materials go. I am in possession of no information respecting its habits, which, however, may be presumed to be the same as those of its congeners; though the weaker feet and proportionally smaller pouches may indicate that the fossorial character is not pushed to such an extreme as is the case with *G. bursarius.*

The written history of the species is brief and precise; the name having been only introduced in 1852. Audubon and Bachman's account is from Le Conte, and Baird redescribes LeConte's type. It is quite possible, and, indeed, probable, that this second Mexican species has figured at times under the name of *mexicanus*, but it would only tend to obscure a matter now clear to drag any such point to light. Now that we know of two perfectly good species in Mexico, the less said about the Tucan of Hernandez, or any similar subsequent uncertainties, the better.

A *Saccophorus quachil*, from Guatemala, was named by Dr. Gray in 1843, though I cannot find that the species was ever described. But through the kind offices of Mr. R. B. Sharpe, who, with the assistance of Mr. Gerrard, examined the type still in the British Museum, at my request, I am informed that it is the animal first described, though subsequently named, by Dr. LeConte.

The foregoing pages include all the species of *Geomys* with which I am acquainted, and account probably for all the names which have been introduced excepting one, *G. heterodus*, recently described, from Central America, by Professor Peters, of which I know nothing. ("Uber neue Arten der Säugthier-Gattungen *Geomys*, Haplodon und Dasypus." < Monatsberichte Acad. Wissensch. Berlin, 1864, Mar. 17, pp. 177–180.)

Genus THOMOMYS, Maxim.

Oryctomys, pt. EYD. & GERV., Mag. Zool. vi, 1836, 23.
Thomomys, MAXIM., N. Act. Acad. Cæs. Leop. xix, 1839, 383.

(In addition to the foregoing, all the synonyms of *Geomys*, *q. v.*, have been applied to this genus.)

The readiness with which the species of *Geomys* may be recognized and defined, is a measure of the difficulties encountered in the genus *Thomomys*, where, with the exception of *T. clusius*, the several forms into which the genus has become differentiated are not yet sufficiently stable to permit of positive, precise determination. After bringing to bear upon the subject an unusually protracted study, in the course of which I have critically examined a hundred or more specimens, I am forced to the conclusion that not a single one of the six or eight currently recognized species is susceptible of satisfactory diagnosis. No descriptive formula can be devised to mark off the characters of any one set of specimens, so completely is the whole series linked together. Nevertheless, it is easy to recognize three extremes of variation (*i. e.*, of differentiation), selected specimens of which would not be confounded by the most careless observer; and it would be as unscientific to ignore these various phases of the genus, as to force them unnaturally apart in an attempt to ignore the still extant links by which they are bound together. There is an unmistakable average of characters, which serves for the recognition of three climatic or geographical races, conspecies or subspecies, which may be described in terms perhaps covering 75 per cent. of existing individuals; but the remainder cannot be thus disposed of. In other words, the causes which have been operative in modifying an original *Thomomys* stock have been only incompletely effectual in the formation of species. We clearly observe the tendency of those modifying influences to which the genus has been subjected; but we note with equal clearness the incompleteness, up to the present time, of the result. Nor is this by any means an exceptional case; on the contrary, positive diagnosis of forms, or specific distinctions in the proper sense, become impossible, *in perhaps a majority of cases*, when sufficient series of specimens are examined. As I have frequently remarked before under different modes of expression, the ability to define species satisfactorily is a very good gauge of our ignorance of the whole truth.

But naturalists practically work, for the most part, upon the surface of the subjects presented to their examination, not necessarily concerning themselves at all times with what lies hidden underneath. There are occasions to speculate and theorize, and there are other times when a naturalist may legitimately ignore underlying principles, and properly content himself with statement of certain observed facts. Working on this plane, as I am in the present instance, it is my business to render an exact account of what I find the case of *Thomomys* to be, without reference to abstract questions involved; and to sum the statement in such nomenclatural terms as I may judge most suitable to express the relationships believed to subsist between the several differentiations which the genus has undergone. In describing the several forms of *Thomomys*, I waive the question of species; no harvest would be garnered if the laborers waited till they learned how the grain grew. In studying my specimens, I find that one of them differs from all the rest to such a degree that its characters are totally irreconcilable with those of any others. My description of it is merely an amplification of this statement. I give it a name, and call it a species, conventionally, simply in recognition of this fact, and for the usual purpose of readily indexing the items of information the specimen affords. I find, furthermore, that all the other specimens collectively present a varying sum of characters, according to difference in the emphasis of each one of these characters common to all; and that their interrelation or intergradation is so intimate and complete that no lines of precise distinction can be drawn; but that, nevertheless, an average difference in *three* directions may be readily perceived and described intelligibly. It is an undoubted fact, furthermore, that these three differentiations are related in some way to certain geographical areas, for the simple reason that all the specimens of one style are produced in certain portions of the country, and all of the rest in certain other regions; and that the *Thomomys* existing on the confines of the several areas share each others' peculiarities. It is, once again, within the experience of those who have studied such subjects in their general bearings, that the aspects of the case presented by *Thomomys* tally exactly with those determined in a great many other cases.

Not to pursue this subject to the extent of further allusion to laws fairly deducible from such premises, it is a logical inference from what has been said that there is but one "species" among all these specimens. This "species" is modified by some unknown means, evidently related in some way to the climate, soil, vegetable productions, or other peculiarities of certain geographical areas, yet not to the extent of severing the links which bind all its individuals together. This species, in the course of time, by the continued operation of the same influences, may or may not be resolved into three or more species in the current acceptation of the term; but at present such is not the case. It is my intention, in the following pages, to describe these variations in detail. In so doing, I consider it advisable, for convenience' sake, to give them each a name; and, in so doing, I shall adopt a formula of nomenclature which I consider best suited to suggest the intergradation which I find to exist, without reference to Linnæus or to the British Association.

It may tend to take the edge off the imputation implied in the remark made above, that six or eight species admitted by naturalists of high repute must be reduced to one, to briefly review the written history of *Thomomys*. The literature of the subject is unusually brief, and it is somewhat surprising how much of it is pure compilation, which has no actual bearing upon the case. Eydoux and Gervais, and Maximilian, each described a species, and Waterhouse and Brandt have both handled the general aspects of the case; but, with these exceptions, almost no original work appears from foreign authorities. Fischer, Schinz (whose one new species was a self-confessed synonym), Wagner, Giebel, and doubtless other systematists, have treated of a number of species of *Thomomys*, but entirely at second hand. Such authorities may be passed over in respectful silence, having no weight whatever. The very slight knowledge from abroad will seem the less remarkable when we find how little has been done by the naturalists of this country. Rafinesque's animals appear to have been all *Geomys*. Godman had nothing to say upon the subject. Bachman's descriptions of two species, in 1839, were upon Richardson's MSS. DeKay enumerated some species at second hand. Audubon and Bachman's accounts of several species add positively nothing to what was already extant upon the subject. When LeConte monographed the family in 1852, he knew but a single species, giving compiled indications only of several others. Woodhouse described a new species in 1853. Various naturalists of the Pacific Railroad Surveys furnished field-notes of observation, but their determinations, to state a well-known fact, were not upon their own authority. In fact, the literature of the whole subject, so far as original work in determination of species is concerned, focuses only in two authors—Richardson, 1829, and Baird, 1857.

No species of *Thomomys* having apparently been described before 1829, the history of the genus may be considered to begin at that date. The eminent author of the Fauna Boreali-Americana gave five species of "Geomys" and "Diplostoma." One of these is a true *Geomys;* the four remaining ones (*douglasii*, *bulbivorum*, *talpoides*, and *umbrinus*), to which a fifth (*borealis*) was subsequently added, are all *Thomomys*. These accounts of Richardson's remained for many years the principal, and, in some cases, the whole, source of what has been written upon the determination of species; and they include every form of the genus known up to this date (every subsequent name proposed having proven a synonym). I hardly know where to look for the parallel of this curious case. Two points strike one in reviewing Richardson's work: First, he had a wholly erroneous idea that there were two distinct genera, "Geomys" and "Diplostoma," in one of which the pouches, opening into the mouth, dangled naturally as sacks on each side, and in the other of which the pouches were as we know them to be. This radically wrong premise vitiated all his work, and led him to the length of describing one and the same species as "Geomys douglasii" and "Diplostoma bulbivorum." Secondly, the minute descriptions consist mainly of the repetition, under varying forms of expression, of generic characters, common, of course, to all the species. When sifted of their generalities, there is very little left; though, fortunately, such was this author's habitual accuracy, the residuum suffices, when coupled with the indications of locality, for the identification of all his species.

As already stated, there was little real change in the state of the case from 1829 to 1857, when Professor Baird reviewed the subject, with considerably more material and much more other information than Richardson appears to have possessed. "Diplostoma" had meanwhile been effectually disposed of; but to this author is due the credit of having first actually identified with specimens several of Richardson's species, which, though often re-appearing by name, remained names only, with copied or compiled accounts attached. Professor Baird's only compilation was in the case of *Thomomys* "talpoides," which he did not claim to recognize. He examined the Philadelphia types of "borealis" and "townsendii," which Dr. LeConte had already satisfactorily located. He referred "Diplostoma bulbivorum" to the Californian form, remarking upon its close affinity to *T.* "douglasii," and established the identity of "umbrinus" with the New Mexican form. He adopted as distinct species the *T. rufescens* of Maximilian and *T. fulvus* of Woodhouse, and added a new one, *T. laticeps*. His descriptions are like those of Richardson's in their minuteness and accuracy, which leave no doubt of his meaning, and the continual recurrence of comparative expression favors recognition of the discriminations made; but, as in the former case, they include much repetition of generic characters. It is a significant fact, however, that in this article the author omits the admirable antithetical tables he usually gives, and throughout seems to have rather undertaken the identification and description of the species currently recognized at the time, than a critical revision of the subject. Alluding to his lack of adequate material, he frankly characterizes the article as "a very unsatisfactory account." I have only to add to this, that, as is well known, the tendency at the time Professor Baird's article was written was to push specific discriminations beyond a point now usual.

Under such circumstances as this sketch of the history of the genus shows to have existed, it would be singular if some combination of currently-recognized species were not required. The reduction I find necessary, and propose to make, is after all not a violent one. Holding for the moment the three forms I shall describe as geographical races to be species—and they would be so regarded by any one working upon a moderate number of specimens—the following are the only combinations required:

Baird, 1857.		Coues, 1875.	
1. *Thomomys bulbivorus* ..	Pacific coast region	BULBIVORUS ..	As well-marked geographical races of one species not completely differentiated.
2. *Thomomys laticeps*			
3. *Thomomys douglassii* ..			
4. *Thomomys ?borealis.* ..	Northern Interior	TALPOIDES	
5. *Thomomys rufescens* ...			
6. *Thomomys "talpoides".*			
7. *Thomomys umbrinus* ...	Southern Interior and Lower California	UMBRINUS	
8. *Thomomys fulvus*			

Of these eight species which Professor Baird gave, one, "talpoides," is not really indentified by him, as he only copies Richardson's account; and another, *borealis*, he says himself he failed to recognize satisfactorily. This leaves only six which he actually indorsed "Borealis" had already been identified by LeConte with *rufescens;* and the animal I describe as "talpoides" is the same as his under another name, resulting from the identification with it of Richardson's species. Another name is thus diposed of. That Woodhouse's "fulvus" is an absolute synonym of what Baird called *umbrinus*, I have satisfied myself by inspection of his type-specimen. Respecting the Pacific-coast form, it is perfectly easy to trace the complete intergradation between the northern (*douglasi*) and southern (*bulbivorus*) extreme. Of "laticeps," no second specimen is known; some of the external characters are altered, apparently, by skinning and drying after immersion in alcohol.

In accounts of the species of this genus, much stress has been laid upon size and shape as distinguishing marks, even by those who are fully aware, not only of the high normal variability in these respects, but also of the peculiar susceptibility to overstuffing, and to various distortions of parts. Nowhere else, perhaps, has bad taxidermy made such a break; it is responsible for different genera, to say nothing of various species. The skin of the whole body, like that of the pouch, is extremely distensible, and *several* inches may be added to the stature of any individual by overstuffing, without leaving any very obvious trace. The peculiar configuration of the body at the base of the tail renders nice measurement of that member very difficult. The feet, particularly the fore feet, shrink and cramp in drying, so that neither their size nor their shape can be appreciated. Upon removal of the skull, the mouth-parts infallibly lose all semblance of nature in drying. In *Geomys*, it is the same; but there the species are so well marked that the worst taxidermy can hardly obscure them. After careful examination of many specimens, fresh, alcoholic, and dried, the following is the full extent of the discriminations I have been able to make:

Size.—The Northern Interior form and the Pacific-coast form are of the same size; the Southern Interior form averages an inch or two less in total length than the other; but large specimens of the latter, and small examples of the two former, overlap each other in stature.

Form.—The Northern Interior race and the Northern styles of the Pacific-coast race have larger fore claws than the Southern style of the Pacific-coast race or than the Southern Interior race. The difference is sufficient to make the whole hand of the former about equal to the foot, while, in the latter, the hand is usually shorter than the foot. But this is only true as a rule; there are many exceptions. In all three of the forms, the tail, measured from its true base, ranges from one-third to one-half the total length of head and body, though only rarely reaching either of these extremes. Nothing can be predicated on this score.

Color.—The Northern Interior race is a rat-colored animal, hoary-gray underneath, with white tail and feet, much white about the mouth, and no sooty-blackish there. The Pacific-coast race is a rich dark-brown animal, muddy-bellied, with dusky tail and feet, wholly or in part, and sooty about the mouth. The Southern Interior race is usually a rich tawny or fulvous animal, with partly dark tail or feet, or both, sooty mouth-parts, and white pouches. This race is particularly variable in color; and, in every respect of color, all the races show much variation, and, moreover, intergrade completely.

The various forms under which the genus *Thomomys* is exhibited may be discriminated, as far as it is possible to do so, by the following characters:

A. Large. Hind foot an inch or more long. Tail at least one-third as long as head and body. Above brown, reddish, &c. Below gray, brown, reddish, &c. (not white). Ears in a blackish area well developed..... 1. TALPOIDES.

a. Six to eight inches long; fore claws highly developed (0.45 to 0.55 long), making the hand about as long as the foot. Color of the house-rat, with white tail and feet, and usually white about the mouth and throat; no contrasts of dark color about the mouth. Northern Interior... a. *talpoides.*

b. Seven to nine inches long; fore claws less developed, usually under 0.50, leaving the hand shorter than the foot. Reddish-brown, the belly muddy-brownish, feet and tail usually not entirely white; mouth-parts dark, contrasting with white of the pouch-lining. Pacific coast..... b. *bulbivorus.*

c. Smaller on an average; usually six to seven inches long. Fore claws about 0.40 or less, leaving the hand decidedly shorter than the foot. Rich fulvous, or even fawn-color, the same below but paler, variously obscured on the back with dusky; tail and feet usually dark; face and mouth-parts sooty-blackish, sharply contrasting with white pouch-lining. Southern Interior and Lower California.................... c. *umbrinus.*

B. Small; decidedly less than six inches long. Hind foot about 0.75; fore foot still less. Tail scarcely one-fourth as long as the head and body. Above, pallid yellowish-gray, with a shade of light-brown; below, entirely white; feet and tail white. Ears minute, not in a blackish area. Nose blackish. Bridger's Pass, Rocky Mountains............................. 2. **CLUSIUS,** *n. s.*

THOMOMYS TALPOIDES, (Rich.) Baird.

Cricetus talpoides, RICH., Zool. Journ. iii, App. 1828, 518. (Plumbago-colored.)

Geomys talpoides, RICH., F. B. A. i, 1829, 204; Rep. Brit. Assoc. for 1836, v, 1837, 157. (Same as the preceding, but "Florida" assigned wrongly as a locality.)—DEKAY, N. Y. Fn. 1842, 92. (Compiled from Richardson.)—SCHINZ, Synop. Mamm. ii, 1845, 137. (Compiled from Richardson.)—LECONTE, Proc. Acad. Nat. Sci. Phila. vi, 1852, 162. (Compiled from Richardson.)

Saccophorus talpoides, FISCH., Synop. Mamm. 1829, 588 (marked "388"). (Compiled from Richardson.)

Ascomys talpoides, WAGN., Suppl. Schreb. iii, 1843, 390. (Compiled from Richardson.)

Pseudostoma talpoides, AUD. & BACH., Q. N. A. iii, 1853, 43, pl. 110. (Compiled from Richardson; figure from the type-specimen.)

Geomys (Thomomys) talpoides, GIEBEL, Säug. 1855, 530. (Compiled from Richardson.)

Thomomys talpoides, BAIRD, M. N. A. 1857, 403. (Compiled from Richardson.)

Geomys borealis, RICH., Rep. Brit. Assoc. for 1836, v, 1837, 156. (Named, not described. "Saskatchewan.")—BACHM., Journ. Acad. Nat. Sci. Phila. 1839, 103. (Originally described from Richardson's type, "Columbia R.," marked "*Pseudostoma borealis,* Rich.")—DEKAY, N. Y. Fn. 1842, 92. (Compiled from Bachman.)—SCHINZ, Synop. Mamm. ii, 1845, 136. (Compiled from Bachman.)

Ascomys borealis, WAGN., Suppl. Schreb. iii, 1843, 391. (Compiled.)

Saccophorus borealis, GRAY, List Br. Mus. 1843, 149 ("Canada;" mere mention, with some wrong synonyms).—MURIE, P. Z. S. 1870, 80 (as host of *Œstrus*).

Pseudostoma borealis, "RICH. MSS."—AUD. & BACH., Q. N. A. iii, 1853, 198, pl. 142. (Description and figure apparently from the original specimens.)

Thomomys borealis, BAIRD, Mamm. N. A. 1857, 396, pl. 22, figs. 2*a–e*. (Account from types of "borealis" and "townsendii," in Mus. Phila. Acad., with which a Californian specimen is considered probably identical.)—NEWB., P. R. R. Rep. vi, 1857, 59 (rests on the Californian specimen just mentioned).

Geomys townsendii, "Rich. MSS."—Bachm., Journ. Acad. Nat. Sci. Phila. 1839, 105. ("Columbia R." Described as distinct from "borealis," with much hesitation, entirely in deference to Richardson.)—Rich., Zool. Voy. Blossom, 1839, p. 12*.—DeKay, N. Y. Fn. 1842, 92. (Compiled from Bachman.)—Schinz, Synop. Mamm. ii, 1845, 137. (Compiled.)

Ascomys townsendii, Wagn., Suppl. Schreb. iii, 1843, 391.

"*Geomys unisulcatus*, Gray, Br. Mus."—Gray, *l. c.*

Thomomys rufescens, Maxim., Nov. Act. Acad. Cæs.-Leop. xix, pt. i, 1839, 383; Arch. f. Naturg. 1841, pt. ii, 42; *ibid.* 1861, —; Verz. Säug. N.-Am. Reise, 1862, 149, pl. 4, f. 5 (penis-bone). (In the last quotation, the generic name is spelled "Tomomys.") (Missouri region.)—Schinz, Synop. Mamm. ii, 1845, 134 (exclusive of the synonym *Oryctomys bottæ*, Eyd. & Gerv.). (Compiled from Maximilian; California erroneously assigned as the locality.)—Baird, Proc. Acad. Nat. Sci. Phila. vii, 1855, 335; M. N. A. 1857, 397. (Redescription of specimens from "Nebraska," *i. e.*, Dakota; Forts Pierre, Randall, and Union.)—Baird, P. R. R. Rep. x, 1859, Gunnison's and Beckwith's Routes, Mamm. p. 8, pl. 10, f. 1 (the same).—Stevenson, U. S. Geol. Surv. Terr. for 1870, 1871, 462 (Wyoming).—Ames, Bull. Minn. Acad. i, 1874, 70 (catalogued upon presumption of its occurrence in Minnesota).—Allen, Proc. Bost. Soc. xvij, 1874, 43 (Yellowstone River); Bull. Ess. Inst. vi, 1874, 56, 61, 65 (rather supposed than known to be this species).

Geomys rufescens, LeConte, Proc. Acad. Nat. Sci. Phila. vi, 1852, 161. (Redescribed from types of "borealis" and "townsendii," in Philadelphia Academy, *marked* "Columbia River.")

Ascomys rufescens, Wagn., Suppl. Schreb. iii, 1843, 387.

Geomys (*Thomomys*) *rufescens*, Giebel, Säug. 1855, 530.

Thomomys "fulvus", Merr., U. S. Geol. Surv. Terr. for 1872, 1873, 665. (*Nec* Woodh.—Err. test. specim. ipsis.)

Diagnosis.—Coloration almost exactly that of the house-rat (*Mus decumanus*)—sometimes assuming a more reddish phase, occasionally blackish-plumbeous; tail and feet white, and much of the chin, throat, and breast white in irregular patches, where the fur is white to the base. No sooty-blackish about the mouth-parts; no obvious distinction in color between the pouch and its surroundings; no strongly-pronounced reddish-brown on the under parts; general tone of coloration never decidedly tawny. Ears set in a small blackish area. Length 6 to 8 inches; tail 3 inches or less, decidedly less than half the length of head and body; fore and hind feet (claws included) approximately equal to each other, about 1.25; longest fore claw little less than the length of the rest of the hand, about 0.50.

Habitat.—Supposed to occur in the Interior of North America, from "Hudson's Bay" to the "Columbia River", and to occupy about the northern half of the United States west of the Mississippi, exclusive of the Pacific-coast region; being replaced, to the west, by *T. bulbivorus*, and, to the south, by *T. umbrinus*. Undoubted specimens seen from Selkirk Settlement, British America; from Minnesota westward along the parallel of 49° N. to the Rocky Mountains, and from Idaho, Wyoming, Utah, and Nevada.

Description (from a series of skins taken by myself along the northern border of Dakota—the details of external form checked from alcoholic specimens from Fort Bridger; in the latter respects, the account represents an amplification of the generic characters, and serves as a standard of comparison for the other species, in the account of which these full details need not be repeated).—So close is the general resemblance of this animal to *Geomys bursarius* that, when the incisors are not examined, a second glance is required to distinguish them. The most obvious points of difference are the much smaller and weaker fore claws, altogether less mole-like (spade-like) hands, and the decided though small external ears. The cheek-pouches are ample—if anything, more capacious than in *Geomys bursarius* or *tuza*, and very decidedly larger than in other species of that genus. They extend fairly past (over) the shoulders to a point about opposite the elbow, when the fore limb is in a usual position. In comparison with species of its own genus, there are, in *T. talpoides*, absolutely no decided points of difference in form. With very little modification in some details, one description is equally applicable to them all, excepting *T. clusius*, in which there are tangible distinctions.

The general arrangement of the mouth-parts is as in *Geomys bursarius*. Beneath the whisker-patch, on each side of the muzzle, about half-way from nose to eye, the fold of skin arises and curves loosely around, to subside again in the common integument over the posterior angle of the under jaw. In a full-grown animal, the slit is an inch and a half long; the "slack" of the edge of the pouch may be pushed an inch or more away from the cheek; the amplification of the sac is here at a maximum—it reaches past the shoulder, as already said, and, in a full-grown animal, two fingers may be inserted to the second joint. The arrangement of the immediate mouth-parts is such that, as in *Geomys*, the mouth appears to be a vertical fissure instead of a horizontal one, bounded on either side by thick, fleshy, and hairy lips. This, however, is only the vestibule of the mouth; the buccal orifice proper being small, closing horizontally of course, as usual, remote from the upper incisors. which are shut out completely by a long, vaulted, hairy interval. The mucous membrane of the cheeks only fairly reaches the edge of the lips in a small patch on either side, and just in advance of the under incisors. Besides the general hairiness of the buccal vestibule, there are longer and more bristly hairs, depending like a fringe around the roots of the incisors, and margining the false lips for some distance.* The upper incisors are smoothly convex on their front face, with a very fine line of impression running immediately along their inner margin. This groove, always delicate and liable to be overlooked, is sometimes obsolete, or, at any rate, fails to run the whole length of the tooth. The inferior incisors are similar, but longer, narrower, and with no sign of a groove. The blunt, tumid snout is entirely hairy, excepting a small nasal pad, strictly confined between the nostrils. The whiskers are very numerous, very fine and soft bristles (mostly colorless), and the longest of them do not equal the head in length. A few slight straggling bristles grow over the eyes and elsewhere about the head. The eyes are situated about midway between the nose and ears; they are small, only about an eighth of an inch in diameter, with rather tumid lids. A notable peculiarity of the species of *Thomomys*, in comparison with *Geomys*, is the presence of external ears, about which there is no question. In *Geomys*, the mere rim of integument warrants use of the terms "rudimentary" or "obsolete." In *Thomomys*, there is a very evident auricle, which rises behind, something like a quarter of an inch above the head; nor is it a mere rim even of this decided dimension; it tapers to quite a point behind, and the lower border of the conch shows a slight folding, which represents a rudimentary lobule. The cavity of the auricle admits the end of my pen-holder; the external meatus itself would admit a pigeon-quill.

In the general shape of the body, there is nothing but what is shared by all the species of the family. The amplitude of the pouches is such that the width across them is much the greatest diameter of the body. The next greatest girth is around the belly; the chest-measure is a little less than this. The fore and hind feet are as nearly as may be of the same length; either may slightly exceed the other, the difference being mainly due to varying development of the fore claws. These, though decidedly fossorial (a family-character), are not so enormously developed as in *Geomys bursarius*, being decidedly less than half the total length of the hand. The digits have the same relative lengths, taken either with or without their claws: the 3d is longest, with the largest claw; the 2d is next; the 4th next, being about as much shorter than the 2d as this is less than the 3d; the 5th is abruptly much shorter, the tip of its claw scarcely or not reaching the base of the 4th claw; the 1st is shorter still, a mere stump, with a little knob for a claw.

---

* No idea whatever of the true configuration of the mouth-parts in this family can be gained from dried specimens from which the skull and teeth have been removed.

The longer claws are much compressed, moderately curved, acute, falcate, or sharp-edged underneath, except at the end, where the sides separate with a slight excavation. The back of the hand is moderately pilous, with short, soft hairs; the toes being fringed with rather longer and more bristly ones. The perfectly smooth and naked palm ends behind in an immense protuberance (as elsewhere in the family), which consists, in effect, of an exterior and an interior callosity, united by a slightly-constricted isthmus. This wrist-bulb is overhung by a special tuft of short, bristly hairs. The sole is naked like the palm, but much narrower and longer (the equality in total length of hand and foot being brought about by the length of the fore claws); it contracts regularly from before behind, ending in a prominent but narrow calcaneum. The upper surface of the foot is hairy like the back of the hand. The 3d digit is longest; the 2d and 4th are subequal to each other, and the tips of their claws reach about to the base of the middle claw. The 1st and 5th are again about equal to each other, but abruptly much shorter than the others; the tips of their claws hardly or not attaining the base of the 2d and 4th digits. The hind claws are of the same character as those of the hand, but very much shorter.

The tail, as in other species of the family, is surrounded at base by a conical enlargement—a prolongation of the body, haired like the rest of the frame, which, in the rutting-season, becomes highly tumid underneath, rendering it still more difficult to say where the tail actually begins. Measured from its true base, as well as this can be ascertained without dissection (from the true base as far as external form is concerned), the tail is more than one-third, but decidedly less than one-half, of the length of head and body together—say about two-fifths. In an average specimen, 7 inches long, the tail may be about 2.75. Measured from where the long hair of the body ceases, or from its apparent base, the tail is about one-third of the length of head and body. This member is somewhat quadrangular, the flattening being especially noticeable underneath; it gradually tapers to an obtuse tip, and is pilous throughout, being clothed with short, soft hairs like those covering the hands and feet.

In the male as well as in the female, the genital aperture is immediately in front of the anus. In the rutting-season, the enlargement of the parts is chiefly post-anal; there being a great swelling behind the anus, which carries the anus away from the apparent base of the tail. The os penis is a slender, sharp spicule, clubbed at base, tapering and slightly curved, nearly three-quarters of an inch long. In a female, I have distinctly made out twelve mammæ, of which two pairs are inside the thigh, two pairs on the chest, and two pairs axillary.

Few, however, if any, of the foregoing points are diagnostic of the species; nor will the *ensemble* serve to distinguish it infallibly from its congeners, excepting *T. clusius*. As to form, the single character I notice is the greater average development of the fore claws, bringing the length of the hands up to about that of the feet. Some points of color about to be noticed are the most reliable distinctions. The animal is as nearly as possible like the house-rat (*Mus decumanus*). The whole upper parts are of a uniform grayish-brown, generally quite pure, though occasionally warming into a more reddish-brown. But, in the most reddish specimens, the tint is uniform, without the peculiar mottling or lining of a dark-brown with a reddish-brown which constitutes the richer color of the Pacific-coast *bulbivorus*. The only departure from the uniformity of the upper parts is a small blackish patch, usually very evident, in which the ears are set. On the sides of the body, the color gives way gradually to the lighter tint of the under parts: here we find the plumbeous of the roots of the hairs as a background to a hoary-grayish, resulting from the tips of the hairs. This hoary is usually quite pure, but it sometimes takes on an appreciably muddy-brown tinge, still never equaling, as far as known, the richer fulvous-brown which tones the under parts in the coast form. The tail and feet are white in every specimen I have seen; and, besides this, there are usually patches about the mouth, cheeks, throat, and breast, where the fur is pure white to the roots. But these white markings are wholly indeterminate in extent, as well as inconstant in appearing at all; in many cases, the parts are concolor with the rest of the under surface. Perhaps the strongest color-mark of the species is the absence from any part of the head of sooty-blackish or even dusky areas, there being no noticeable contrasts of color between the mouth-parts and pouches; whereas, in *T. bulbivorus*, and, still more so, in *umbrinus*, these parts are dusky, or even coal-black, contrasting sharply with the pure-white linings of the pouches. The whiskers are mostly colorless; the claws are colorless, though usually stained with extravasated blood.

Northern Dakotan and Minnesotan specimens may be taken to represent the extreme of this race as above described, characterized by the purity of the gray and brown shades, absence of any decided reddish cast, and pure-white feet, tail, and throat. Specimens from Selkirk Settlement and the Assiniboine region are identical. Others, from Idaho, Nevada, and Utah, are too nearly similar to admit of any intelligible noting of differences; though, as might be expected, there is a slight tendency to the characters of *bulbivorus*.

A few specimens before me from Southern and Western Dakota, being those that Baird referred to "rufescens," with one from California, which he placed under "borealis," and one lately received from Fort Benton, Montana, are more decidedly reddish-brown than any of the above. They are unquestionably exactly what Maximilian called "rufescens." They are all considerably smaller than average *talpoides;* and, if I could satisfy myself that they were full-grown, something more would have to be said upon the subject. As it is, however, I can make out no satisfactory distinctions from ordinary *talpoides*. There are only five or six of these small rufous specimens before me; fuller series may indicate some tangible distinctions.

The following measurements indicate the average dimensions, and, to some extent, the variation, of this species:

Current number.	Locality.	Sex.	From tip of nose to—				Tail to end of vertebræ.	Length of—		Longest fore claw.	Nature of specimen.
			Eye.	Ear.	Occiput.	Tail.		Fore foot.	Hind foot.		
11515	Souris River, Dakota....	×	1.00	1.60	1.75	7.00	2.50	1.25	1.25	0.55	Fresh.
11517	Pembina, Dakota	♀	0.75	1.40	1.60	6.25	2.75	1.15	1.25	0.55	Fresh.
11518	Pembina, Dakota	♂	0.90	1.60	1.70	7.50	2.50	1.20	1.20	0.50	Fresh.
11520	Pembina, Dakota.	♂	0.90	1.50	1.90	7.25	2.75	1.25	1.20	0.45	Fresh.
11522	Pembina, Dakota	♂	0.95	1.60	1.80	7.00	2.60	1.25	1.20	0.55	Fresh.

NOTE.—The foregoing specimens, all adult, taken the same season (June to September, 1873), were carefully measured in the flesh by myself. Other specimens, from the same region, not measured in the flesh, carry the limits of total length from about 6 to about 8 inches, with a corresponding range of variation in other parts. The tail is taken from its true base—it appears about half an inch shorter in the dried state. The weight of these specimens ranges from 6 to 7 ounces. The girth of the chest is about 5 inches; of the belly, 6.50. No. 11517, ♀, has 12 teats—2 pairs axillary, 2 pairs pectoral, 2 pairs inguinal When fully distended, in the fresh state, the width across the cheek-pouches is the greatest diameter of the body.

Distribution.—The most northern specimen I have seen is from the Assiniboine River; the species is supposed to range from Hudson's Bay to the Rocky Mountains in British America (northern limit unknown). In the United States, I have specimens from Minnesota, Dakota, Montana, Idaho, Nebraska, Wyoming, Nevada, and Utah. The southern limit is likewise unknown, but inferred to be somewhere along the middle of the United States. Its range, probably, does not inosculate with that of *T. umbrinus;* at any rate, I have seen nothing intermediate in character from anywhere in the Interior. The approach to *umbrinus* seems to be only made in the Pacific province, through *bulbivorus*. *Talpoides* exists fairly westward of the main chains of the Rocky Mountains; but no *Thomomys* of this style is known from immediate Pacific slopes. It meets and inosculates with the Northern style of *bulbivorus* ("douglasi") in the Columbia River region.

Synonymy.—The name "talpoides," coupled with various generic terms, is of frequent appearance in works on natural history; but, so far as I know, everything relating to it is pure compilation, the species never having been hitherto actually identified. The sole advance upon Richardson's original accounts is Audubon's figure of the type-specimen. A difficulty in the way of identifying Richardson's animal seems to have been an expression he used with regard to the number of digits. But it is morally certain that no such difference exists in the genus *Thomomys*. In some other cases, as in *Muridæ* and *Sciuridæ*, strict interpretation of Richardson's remarks in this regard would throw his species out of the question; for he speaks more than once of four perfect digits, and a rudimentary one, as in this very case. The diagnosis in the Fn. Bor.-Am. is: "grayish-black, with white chin, throat, and tail, and only four *perfect* toes on the hind feet." The expression "cinerascenti-niger" is no obstacle; for here, as in the genus *Geomys*, there is a plumbago-state of pelage. The "white chin, throat, and tail" are diagnostic, in fact, of the animal I here describe, and inapplicable to any other. These facts, especially when coupled with the locality assigned (Hudson's Bay), leave no doubt in my mind that this is the species indicated by Richardson. Furthermore, Audubon's figure from Richardson's type is an unusually faithful representation. I consider this point established.

The next names in point of date are "borealis" and "townsendii," both described, in 1839, by Dr. Bachman, from Richardson's MSS., upon specimens in the Philadelphia Academy, said to be from the "Columbia River." These two names may be treated together, as they are unquestionably the same. These specimens, apparently, were figured by Audubon; the plate is too highly colored, the richness of the tint there represented being only matched in strong cases of *umbrinus;* but exactly the same wrong tawny coloration is on the same author's plate of "douglasii," and need not stand in the least in the way of the identification which I make. The same original specimens were taken by Dr. LeConte as the basis of his *Geomys rufescens,* and were examined by Professor Baird, who failed to see any decided difference from "douglasi." I have not taken occasion to handle these specimens myself; but Dr. Bachman's original description gives nothing incompatible with the characters of the present species, and the balance of his account inclines here. From the locality, it is most likely that these specimens are more or less intermediate between pure *talpoides* and "douglasi." It becomes, in fact, a matter of indifference whether we allocate the quotations of "borealis" here or under the next head.

Respecting the *T. rufescens* of Maximilian, I have nothing to add to what has been already said. "Geomys unisulcatus" of Gray, apparently only a museum-name, is here assigned by the author himself. The specimens collected by the United States Geological Survey of the Territories, catalogued by Mr. Merriam as "fulvus," belong here, as I ascertain by inspection.

THOMOMYS TALPOIDES BULBIVORUS, (Rich.) Coues.

Diplostoma? bulbivorum, RICH., F. B. A. i, 1829, 206, pl. 18 B (lettered *douglasii* by mistake).—RICH., Zool. Voy. Blossom, 1839, pp. 9 and 13.*

Ascomys bulbivorus, WAGN., Suppl. Schreb. iii, 1843, 387. (Compiled.)

Geomys bulbivorus, DEKAY, N. Y. FD. 1842, 92. (Compiled from Richardson.)—SCHINZ, Syn. Mamm. ii, 1845, 135. (Compiled; quotes *D. "bulbiferum"*; gives wrong locality).—LECONTE, Proc. Acad. Nat. Sci. Phila. 1852, 162. (Compiled from Richardson.)

Pseudostoma bulbivorum, AUD. & BACH., Q. N. A. iii, 1854, 337. (Compiled from Richardson.)

Geomys (Thomomys) bulbivorus, GIEB., Säug. 1855, 530. (Compiled from Richardson)

Thomomys bulbivorus, BAIRD, M. N. A. 1857, 389, pl. 50, f. 3 *a–g,* and pl. 52, f. 1 *a–g.* (Identifies the common Californian animal with this species of Richardson's, and minutely describes it.)—BAIRD, P. R. R. Rep. x, 1859, Williamson's Route, Mamm. 82. (Tejon, Cal.)—KENNERLY, P. R. R. Rep. x, 1859, Whipple's Route, Mamm. 13, pl. 11. (California.)—GERR., Cat. Bones Brit. Mus. 1862, 223. (California.)

Oryctomys (Saccophorus) bottæ, EYD. & GERV., Mag. de Zool. vi, 1836, 23, pl. 21, f. 4 (teeth); Voy. Favorite, v, 1839, 23, pl. 8, f. 4 (same).

Thomomys bottæ, Less., Nouv. Man. R. Anim. 1842, 119. (Compiled.)—Baird, Proc. Acad. Nat. Sci. Phila. 1855, 335. (Subsequently identified the same with *bulbivorus*.)

Geomys fuliginosus, Schinz, Syn. Mamm. ii, 1845, 136. (Based on *douglasi;* name altered for no good reason.)

Thomomys laticeps, Baird, Proc. Acad. Nat. Sci. Phila. 1855, 335; M. N. A. 1857, 392. (Humboldt Bay.)—Kenn., P. R. R. Rep. x, 1859, Whipple's Route, Mamm. 13, pl. 12, f. 1 (by error marked "2" in text). (Same as the foregoing.)

Geomys douglasii, Rich., F. B. A. i, 1829, 200, pl. 18 C, ff. 1-6 (skull); Zool. Voy. Blossom, 1839, 9. (Near mouth of Columbia; Fort Vancouver.)—LeConte, Proc. Acad. Nat. Sci. Phila. 1852, 162. (Compiled from Richardson.)

Geomys douglasi, DeKay, N. Y. Fn. 1842, 92. (Compiled from Richardson.)

Ascomys douglasii, Wagn., Suppl. Schreb. iii, 1843, 392. (Compiled.)

Pseudostoma douglasii, Aud. & Bach., Q. N. A. iii, 1853, 24, pl. 105 (altogether too brightly colored). (Mainly compiled from Richardson.)

Geomys (Thomomys) douglasi, Giebel, Säug. 1855, 531. (Compiled.)

Thomomys douglassii, Baird, M. N. A. 1857, 394. (Minute description of specimens from Washington and Oregon Territories.)—Suckl., P. R. R. Rep. xii, 1860, pt. ii, pp. 100, 126.

Diagnosis.—Coloration heavier than in the foregoing; general cast reddish-brown, lined with dusky on the back; the head usually darker than the rest of the upper parts; on the sides, the color giving way to a clearer tawny-brown, which occupies the belly also, there overlying the plumbeous roots of the fur as a strong wash. Face and mouth-parts dusky, or even sooty-blackish, contrasting with the white lining of the pouches. No pure white on the under parts. Tail and feet usually incompletely whitish, or quite dusky. If anything averaging rather larger than true *talpoides*. Hand rather shorter than the foot, owing to less development of the claws, which are only about 0.40 long.

Habitat.—Pacific coast and slopes of the United States, from Washington Territory to Southern California.

Description (from San Francisco specimens).—Having already sufficiently insisted upon the fact that there is no decided difference in size or shape between this form and the last, beyond an average less development of the fore claws, there is little to be said by way of description, except to amplify the foregoing points of coloration. The extreme of the *bulbivorus* branch of this species is readily recognized by a warmth and intensity of coloration not known to occur in specimens from the Northern Interior. The color varies a great deal in different specimens, but is never like the clear mouse-gray seen in *talpoides*. It is in reality an intimate mixture of yellowish-brown and dark-brown or blackish. Above, the pointing of the fur conceals the plumbeous bases of the hairs; below, this plumbeous shows, overlaid with a strong wash of tawny or muddy-brown, quite unlike the hoary-gray of the same parts of *talpoides.* The under surface is not known to be varied with patches of white, nor is there any white about the mouth, excepting the immediate border of the lips. On the contrary, the mouth-parts are sooty or dusky, contrasting with the white which lines the cheek-pouches. This is very much as in *umbrinus*, and quite different from *talpoides.* The hands and feet are sometimes white, as in *talpoides*, but oftener merely whitish, and not seldom dusky. I have not seen the tail pure white; it is generally dark-colored for the most part, often wholly so. The fore claws average about 0.40—rather less than more.

Such is the typical manifestation of this form, which I have only seen from California. We have next to trace the change by insensible degrees into both *talpoides* and *umbrinus.* Proceeding up the Pacific coast, we find an animal still like *bulbivorus* in the general tone of coloration (warm-brown above and muddy-bellied), but in which the mouth-parts have nearly or entirely lost their sootiness. Here, also, the fore claws enlarge somewhat, and from this state it is but a step to the grayer true *talpoides*, which joins with *douglasi* in the interior of Oregon and Washington. In the interior of California, the opposite modification begins, tending toward *umbrinus*, which becomes fully established in Arizona and New Mexico. Here the dark mouth-parts are preserved and even intensified, but the color grows richer till a decidedly tawny or fulvous cast is the result. Various specimens from Fort Crook and Fort Tejon, and from Provo, Utah, are of this ambiguous sort, and exhibit among themselves such variations that their labeling becomes a matter of indifference. Some of the browner ones are not separable at all from *bulbivorus*, while the ruddiness of others matches that of true *fulvus.* The gradation of the two forms in this region is demonstrably complete. Some other specimens from Fort Crook are absolutely identical with Steilacoom ones in respect of color; the only difference I can note being the somewhat weaker claws. To the southward, on the coast, the same gradation occurs, becoming established about San Diego. In Lower California, pure *umbrinus* prevails.

A San Franciscan specimen lately received at the Smithsonian is a perfect albino—snow-white all over.

Little further discussion of the synonymy of this form is required than is implied in what has already been said. Professor Baird appears to have first satisfactorily identified the *Diplostoma bulbivorum* of Richardson with the animal subsequently described as *Oryctomys bottæ* by Eydoux and Gervais. Preceding authors' use of the name had been altogether compilation. Schinz's name is a synonym upon its face, being a mere renaming of the same animal. The *T. laticeps* was based upon the individual peculiarities of a single specimen, the characters of which are more or less obscured by drying after immersion in alcohol.

THOMOMYS TALPOIDES UMBRINUS, (Rich.) Coues.

Geomys umbrinus, Rich., F. B. A. i, 1829, 202; Rep. Brit. Assoc. for 1836, v, 1837, 157. "Cadadaguios, Southwestern Louisiana"—more likely Texas.[*]—Waterh., Charlesw. Mag. N. H. iii, 1839, 596, f. 71 (skull).—DeKay, N. Y. Fn. 1842, 92. (Compiled from Richardson.)—Schinz, Syn. Mamm. ii, 1845, 137. (Compiled from Richardson.)—Lec., Proc. Acad. Nat. Sci. Phila. 1852, 162. (Compiled from Richardson.)

Ascomys umbrinus, Wagn., Suppl. Schreb. iii, 1843, 389. (Compiled.)

Pseudostoma umbrinus, Aud. & Bach., iii, 1854, 307. (Compiled from Richardson.)

Geomys (*Thomomys*) *umbrinus*, Gieb., Säug. 1855, 530. (Compiled from Richardson.)

Thomomys umbrinus, Baird, M. N. A. 1857, 399 (redescribed from numerous New Mexican specimens).—Baird, U. S. Mex. B. Survey, ii, pt. ii, 1859, Mamm. p. —.—Gerr., Cat. Bones Br. Mus. 1862, 228.

Geomys fulvus, Woodh., Proc. Acad. Nat. Sci. Phila. 1852, 201 (San Francisco Mountains, Arizona); Rep. Expl. Zuñi and Colorado R. 1853, 51, pl. 5 (the same).

Pseudostoma (*Geomys*) *fulvus*, Aud. & Bach., Q. N. A. iii, 1854, 300. (Copied from Woodhouse.)

Thomomys fulvus, Baird, M. N. A. 1857, 402. (Describes Woodhouse's type, and other specimens, from California.)—Baird, U. S. Mex. Bound. Surv. ii, pt. ii, 1859, Mamm. p. —.—Kenn., P. R. R. Rep. x, 1859, Whipple's Route, Mamm. 14, pl. 12, f. 2.—Coues, Am. Nat. i, 1867, 394 (habits).—Coues, Proc. Acad. Nat. Sci. Phila. 1867, 135 (Fort Whipple, Arizona).

Diagnosis.—Averaging decidedly smaller than either of the foregoing. Length of head and body about six inches, rarely seven. Fore feet averaging decidedly less than the hind feet; longest claw oftener under than over 0.40. Color variable, from a nearly uniform rich fawn-color all over, or even intense reddish-chestnut, to various tawny-brown shades, with or without a blackish dorsal area. Belly merely a paler shade of the color of the upper parts, or much as described under *bulbivorus*. Occasionally quite gray, much as in typical *talpoides*. (Variety: lustrous coal-black all over.) Mouth-parts, and often whole face, blackish, except sometimes immediately around the lips, strongly contrasting with the white lining of the pouch. Tail usually more or less like the body.

---

[*] The probability is heightened by the Spanish appearance of the name, as if a corruption of *Ciudad de Aguas*, "City of the Waters." The locality is now unknown. "Louisiana" was formerly a vague term.

HABITAT.—South Colorado, Southern Utah and Southern Nevada, Western Texas, New Mexico, Arizona, and Lower California to Cape Saint Lucas. Southward extension into Mexico undetermined. "Louisiana."

Description (from extensive series from the above localities).—No other form of the genus varies so much in color as this one. With the increase in intensity and richness of coloration of the genus to the southward, there is a corresponding ratio of variation to or from what may be held the normal mean. Selecting average samples, as, for instance, some I collected at Fort Whipple, Arizona, in 1864–'65, we observe a very rich tawny or fulvous pelage, more or less obscured on the back by a blackish area. The under parts are of the same color, paler or of about equal intensity, with the deep plumbeous bases of the hairs showing. The ears are set in a small blackish area; the face, and, to a less extent, the top of the head, are blackish, with or without white spots on the lips or chin, contrasting strongly with the white lining of the pouches. The feet are indifferently whitish or dusky; and more or less of the tail is usually colored.

Other specimens, by the extinction of the blackish dorsal area, become nearly concolor all over, and of so rich a hue as to almost bear the term golden-brown. There is a great similarity in many cases to the coloration of *Jaculus hudsonius* or *Arvicola aureola.* The best-marked samples of this style before me are from Southern Arizona and Cape Saint Lucas, where this appears to prevail. Dr. Woodhouse's type of "fulvus" is entirely of this color above, with nearly white belly. Specimens from the Colorado Valley exhibit another style of coloration in their extreme pallor, from the bleaching of fulvous into a pale brownish-yellow, and with whitish belly. A specimen from "Sonora" (rather Southern Arizona, as now bounded) is dark-cinnamon or chestnut-red, with blackish dorsal area. More northerly specimens tend to grayer tints; but this grayishness has a plumbeous cast, and is suffused on the sides with tawny. The belly in these cases is as purely hoary-gray as in typical *talpoides;* and one specimen, from Fort Massachusetts, is exactly rat-colored, and indistinguishable from pure *talpoides*, except in being smaller, though it is apparently very old. In this specimen, too, the characteristic markings of the mouth-parts and pouches are much obscured, and the fore claws are fully as long as in some northern examples of *talpoides*. Half-grown specimens, as elsewhere in the family, are lead-colored, merely paler below.

A melanistic specimen from Cantonment Burgwyn, New Mexico, is a uniform, intense, lustrous plumbago color (almost like anthracite coal), with white lips and pouches.

In this form, which exhibits such variation as well as intensity of color, we observe more clearly than elsewhere the changes produced in the shedding and renewal of the pelage. It seems to be the rule in this genus, as in *Geomys*, that the hair is cast from before backward by a regular progression. As already hinted, the animals appear to grow gray with age; but, besides this, each annual or seasonal coat seems to lose its richness of coloration toward the time that it is to fall off, and the fresh coat comes out more heavily tinted. It results from this, in connection with the peculiar mode of shedding, that patchy specimens are of frequent occurrence, with a sharp line of demarkation between differently-colored areas (*Geomys castanops* is a notable case of this). Some examples before me are, in fact, strong "umbrinus" in front and very fair "bulbivorus" behind. Season, as well as age, doubtless influences the color of the pelage, but exactly to what extent I am unable to say, owing to the usual oversight of collectors in neglecting to date their labels.

The geographical distribution of the species, as far as now known, is indicated in a preceding paragraph. The original locality given for *umbrinus* has not been checked by subsequent accounts, and is probably somewhat out of the way; Texas or New Mexico being more likely the source of the type-specimen described by Richardson. I see no occasion to question Baird's identification of the species, with which the *Geomys fulvus* of Woodhouse is indisputably identical.

THOMOMYS CLUSIUS, Coues, *nov. sp.*

Sp. Char.—Smallest known species of the genus. Length (♀, *adult*) about 5 inches. Feet remarkably small; sole of hind foot 0.75; palm of hand, including longest claw, 0.65. Fore claws small, weak, little curved, the longest under 0.30. Incisors as usual in the genus. Muzzle almost entirely hairy, with a very small naked pad confined between the nostrils. Pouches ample, about 1.75 deep (measured from the beginning of the fold of skin at the side of the snout). Tail extremely short; under 1.50 in length from the true base, and little over 1.00 from the end of the conical enlargement at base; the thinly-haired portion being thus less than one-fourth the total length of head and body. Ears minute. Color above pale yellowish-gray, with a slight light-brown shade; the fur plumbeous at base, as usual. Below, nearly pure white, the fur being mostly of this color to the very base. No dark auricular area. Feet and tail white. Extremity of snout blackish. Claws and whiskers colorless. Incisors faced with orange.

HABITAT.—The single specimen of the species at present known, No. 3051, Museum of the Smithsonian Institution, was taken at Bridger's Pass, Rocky Mountains, July 28, 1857, by Dr. W. A. Hammond.

With only one specimen to go upon, there is little to be added to the foregoing diagnosis. That the small size is not due to immaturity is evidenced by the fact that the specimen is a female, with functionally-developed teats, which had been in use. As well as I can determine from the dried skin, there are twelve mammæ,* situated as in *T. talpoides*. In its present state, somewhat stretched, the skin measures about 5½ inches from nose to root of tail. The general dimensions, as well as the relative and absolute length of tail and the proportions of the feet, are all quite beyond the utmost limit of variation determined for any other form of *Thomomys*. It may give an idea of the smallness of the feet to say that the hind ones are no larger than those of the white-footed mouse (*Hesperomys leucopus*); they are a trifle broader, but not quite so long. The fore feet are decidedly shorter than the hinder ones, owing to the slight development of the slender weak claws. The ears are minute—scarcely larger, comparatively, than in a *Geomys*, though the tiny auricle has the recognizable shape of *Thomomys*, instead of being a mere tumid rim. The tail, as well as can be guessed from the present dried state, is less than a fourth as long as the head and body, measured from its apparent base. All these characters are utterly incompatible with any variety

---

* This appears to be the normal number in this genus; but, in an alcoholic specimen of *talpoides*, with the fur all gone from the belly, completely exposing the parts, I can find but eight; the two axillary pairs being wanting.

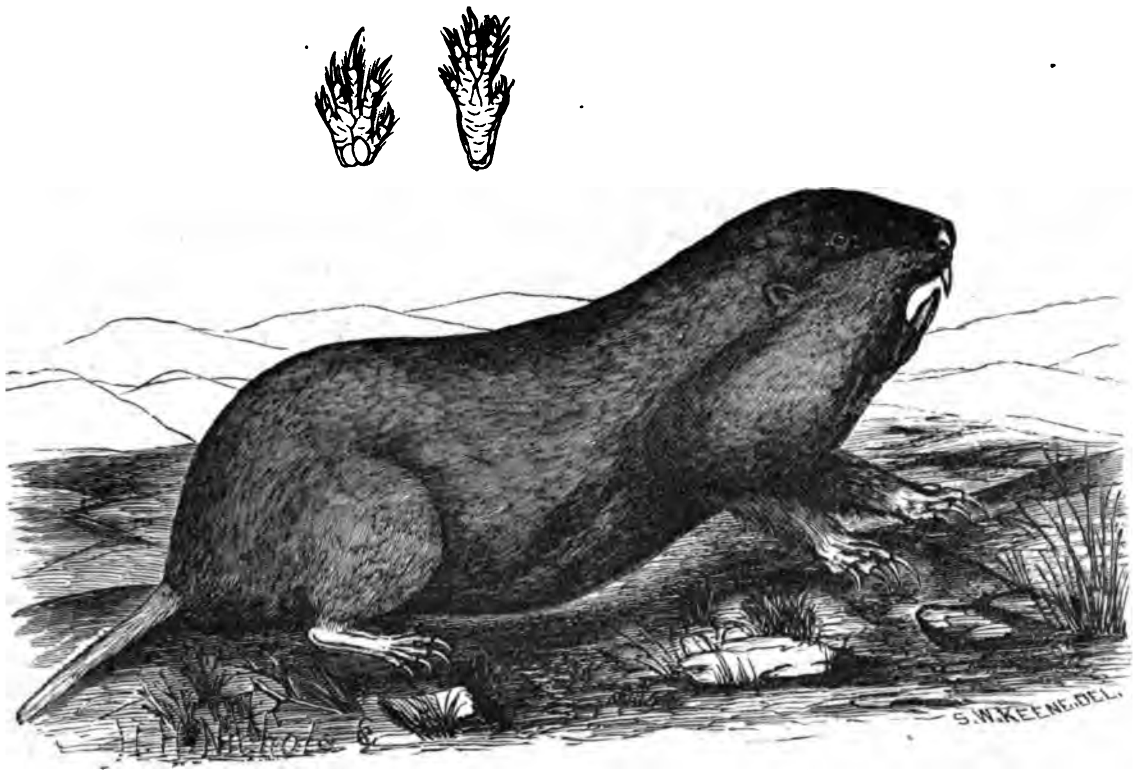
H. H. Nichols Sc.
S. W. KEENE. DEL.

Figure 80.—THOMOMYS CLUSIUS, *Coues*. Natural size.

though specimens differ in this respect, owing to a variable curve of these parts. In adult *Geomys*, the case is as stated, the zygomata converging a little backward in a nearly straight line, so that posteriorly their width apart is little if any greater than the intermastoid diameter of the skull. In *Thomomys*, there is a more decided outward convexity of these arches, and their greatest width apart is nearly at their middle—if anything, posterior to this, and at any rate the width here decidedly surpasses the intermastoid diameter. In front, the zygomatic plates of the maxillaries start out at nearly a right angle with the long axis of the skull; behind, the zygomata curve rather abruptly into the squamosal. There is a deep abrupt emargination behind the posterior root of the zygomata, between this and the postero-lateral corner of the skull; in the recess, the tubular bony meatus auditorius appears protruding in this view. The lambdoidal crest, forming the posterior boundary of the skull, is a slight curve, more or less irregular; most of it is squamosal, for the occipital bone rises to this crest for only a short distance. The narrowest part of the skull is between the orbits, where the width is less than the diameter of the rostrum. The irregularly pyriform figures, circumscribed by the zygomata and walls of the cranium, are of large size; no orbits proper are defined in the general orbital space, owing to deficiency of both pre- and post-orbital processes. The dome of the cerebral cavity is but little inflated; its sides seem somewhat pinched, there being a decided though shallow concavity just above the zygomatic spur of the squamosal; and a slight bulging anteriorly on each side at the usual site of post-orbital processes. The median line of the cerebral roof, in an old *Geomys* skull, is a ridge; this ridge bifurcates anteriorly to send a curved leg forward and outward to the orbital margins; and behind enlarges a little to receive a small interparietal. In various *Thomomys* skulls of different ages, the squamosals leave a rectangular interval occupied by small, narrowly linear parietals; and, instead of a single median ridge, there are two parallel ridges, with a depressed interval. The sides of the rostrum are straight and parallel, the edge being the swollen track of the superior incisors. The end is vertically truncate; the tips of the nasals and intermaxillaries and the faces of the incisors being all about in one perpendicular plane. The width of the rostrum is rather more than half its length.

Viewed from behind, the occipital surface is seen to be nearly plane and vertical, with some beveling of the lateral (mastoid) portions. The most remarkable feature is the extent of this surface which is formed by the mastoid. In *Geomys*, at any rate, the mastoids take as much part in the occipital surface as the occipital bone itself. The upper border of this surface is a nearly regular arch from one squamosal angle to the other. The lower outline is likewise a curve, with its convexity downward, but its regularity is broken by the nick of the foramen magnum in the middle, the protuberance of the condyles next, similar paroccipital processes next, and after a little interval the mastoid processes. Barring these irregularities of detail, the general occipital surface is elliptical in shape. In the middle, and nicking the lower limb of the ellipse, is the foramen magnum, nearly all of which is vertical, and consequently not foreshortened in this view.

Viewed from below, the general contour is substantially like that presented from the opposite inspection, and we need only attend to details. The first feature is the incisive foramina—very small slits lying wholly in the intermaxillary bones, yet nearer to the molars than to the incisors, so great is the production of the rostrum. The palate proper,* *i. e.*, the intermolar portion, is extremely contracted, its width anteriorly being no greater than that of one of the molars. It widens a little backward. It is deeply twice furrowed, having a strong median ridge separating the furrows, and strong alveolar ridges on either hand. Posteriorly, there is a pair of deep pits extending to opposite the penultimate molars, and divided by a strong ridge. The palatal plate upon which these pits are constructed reaches considerably back of the molars in *Geomys;* less so in *Thomomys*. The general resemblance of the parts to some *Arvicolinæ* is strong. The pterygoids are thin, vertical, and somewhat circular plates, divaricating a little posteriorly, and abutting against the tips of the bulla ossea. They appear like a bifurcation of the median palatal ridge just mentioned. The post-palatal parts being contracted, like the palate itself, and compressed into small space, it is not easy to fully appreciate the conformation of the parts, and still less so to describe it. Moreover, the lamellar pterygoids are often broken off in careless preparation of the skull, and in such a way that scarcely a suggestion of their former presence is left. Behind the pterygoids, the conspicuous bullæ ossæ appear convergent anteriorly to touch the former, prolonged into a tube exteriorly. Between them, the basi-occipital space is cuneiform (especially in *Thomomys*—more nearly quadrangular in *Geomys*), with a median ridge and lateral depressions, nicked behind by a small portion of the foramen magnum. The skull finishes behind by an irregular curve, substantially the same as that described in speaking of the occipital plane.

---

* The long upward-sloping anterior part of palate is not "palate" at all. In life, it is altogether outside the mouth, like the superior incisors, and covered with furry skin.

In all but the oldest animals, the following sutures, or, at any rate, traces of them, persist: internasal, naso-intermaxillary, maxillo-intermaxillary, fronto-nasal, fronto-intermaxillary, and fronto-maxillary; maxillo-malar, squamo-parietal, squamo-malar, squamo-mastoid, occipito-mastoid, occipito-petrosal; basi-occipito-sphenoid; and there is fissured separation of the petrosal and tympanic from the squamosal. The various intricate relations of the palatals, and of the "sphenoid" as a whole, are inappreciable in the adult skull. Detailed relations of such of the individual bones as can be made out from the material before me here follow:

The nasals reach back to a point opposite the anterior root of the zygoma, but extend little, if any, in the other direction, beyond the intermaxillaries. For two-thirds their extent they are narrow and approximately parallel in the examples of *Geomys* before me, and then rapidly expand. In all the *Thomomys* I have seen, they widen regularly from the base to tip. They are flat at first, but toward the end become somewhat volute or scroll-like. They remain permanently distinct from the intermaxillaries, and have failed in no case to show me separation from each other.

The intermaxillaries run up on the forehead farther than the nasals—to or beyond the back instead of front border of the zygomata, being received in a deep emargination of the frontal. Below, similarly, they run far down on the false palate, ending opposite the back end of the incisive foramina. Their course around the side of the rostrum (maxillo-intermaxillary suture) may usually be traced as a strongly convex curve between the upper and lower points just mentioned, the most forward portion of the curve lying nearly midway between zygoma and incisors. The lateral surface is thrown into a curved elevation, denoting the track of the incisor within. A strong alveolar plate dips down between the front teeth. The maxillary ends anteriorly in the curve just described; its other boundaries are obscured in adult life. The side is flat; it suddenly rises in a broad, thin, zygomatic plate, flush above with the general level of the top of the skull, there abutting (as shown by a long persistent suture) both with frontal and intermaxillary. This plate stands away nearly at a right angle with the axis of the skull, but very oblique to the other two planes. It circumscribes the orbit anteriorly; is excavated in the lachrymal region; its upper border is widened to a sharp-edged surface, and slopes gently outward, downward, and backward; its thin under margin rises to nearly meet the upper, finishing the laminar portion, and continuing to the malar bone as an angular process. A lachrymal bone is plainly indicated at the upper back part of the plate, but its extent and relations are not appreciable.

The frontal is much contracted, especially across the middle, having a somewhat hourglass-like superior outline, though both ends are angular. In front, it sends a rectangular median process abutting against the nasals, and inclosed between the intermaxillaries, and an acute lateral process on each side, entering a recess between intermaxillary and maxillary. These sutures seem persistent. Behind, the fronto-parietal and fronto-squamosal sutures are commonly obliterated; when appreciable, the bone is seen to unite with the extremely narrow parietals by a directly transverse straight line, and with the squamosals by an oblique line on each side. These sutures persist longer on top of the head than in the orbital region.

The malar bone is a mere splint, reduced coincidently with the great extension of the zygomatic spurs of both squamosal and maxillary. It is somewhat clubbed anteriorly and overrides its support; behind, it is itself overlapped.*

The parietals, as already hinted, are singularly reduced in this family. In the skull of an old *Geomys*, the squamo-parietal suture is obscure or inappreciable, and the squamosals appear to meet each other at the above-described ridge on the median line; careful inspection, however, usually reveals a very irregular and much overlapping squamo-parietal suture, defining the parietals externally. These are of indeterminate shape, but tend to be narrowly rectangular; and, in *Thomomys*, a pair of pretty regular linear parietals is usually evident. There is constantly an interparietal—squarish or pentagonal in *Thomomys*, rather triangular in *Geomys*.

---

* Although the zygoma in this family is a good stout arch, this reduction of the malar prepares us for the delicate thread-like condition of the parts in the next family, *Saccomyidæ*.

With such state of the parietals, there is a corresponding overdevelopment of the temporal bone, especially of its squamosal element, though not to the extraordinary extent witnessed in *Saccomyidæ*, where the whole bone is blown up like a bladder. The squamosal roofs over most of the cranial cavity, and alone forms (with the exception of a little place occupied by the interparietal) the whole occipital or lambdoidal crest. The mastoid, which persists distinct from both squamosal and occipital, though usually fusing with the petrosal, is immensely developed, its superficies lying mostly in, and representing about half of each side of, the occipital surface. It develops a moderate "mastoid process", lying against the postero-external corner of the squamosal, and looking like a duplicate of the paroccipital process that lies against its opposite extremity. The petrosal does not share this unusual development, the bullæ osseæ being, in fact, smaller than they are in *Arvicola*, for instance; they swell but little below the baso-occipital plane. The tympanic develops into a tubular meatus, set quite free from its surroundings in a deep recess of the squamosal. The petrosal likewise is fissured away from the squamosal, but, in adult life, the tympanic, petrosal, and mastoid are consolidated.

The upper and lower parts of the occipital bone are at right angles with each other; the basi-occipital is horizontal upon the floor of the skull, while the superior and lateral elements are perpendicular behind. The supra-occipital is squarish, with rounded corners; the ex-occipitals develop into moderate obtuse processes. Nearly all of the foramen magnum is vertical; the condyles are rather small, and widely divergent superiorly

The suture with the basi-occipital, which persists for some time, is ordinarily the most conspicuous of the sphenoidal relations which may be appreciated in examination of adult skulls. Close inspection, however, shows the squamo-sphenoid suture just inside the glenoid fossa; the alisphenoid barely misses taking a part in the mandibular articulation (as in some marsupials);

the orbito-sphenoid, lining the orbit behind, rises nearly to the top of the skull.

The mandible remains for consideration. This is eminently characterized by its massiveness and the emphasis of its various ridges and angles. Nevertheless, the symphysis, though extensive, is incomplete. Instead of an edge below, the bone presents a broad, smooth, flattened area, bounded on the sides by a ridge indicating the limit of masseteric muscular attachment. The angle of the jaw is strongly exflected in a peculiar way. An oblique plate (the "descending process" in many rodents) arises from the inner side of the body of the bone, and curves strongly backward and outward, ending far exterior to the main part of the bone as a strong laminar process. Just inside of this, between it and the condyle, there is a strongly-marked, smooth, upright protuberance. This is where the root of the incisor pushes up from the inside. To the inner side of this knob, again, rises a third protuberance; it is the condyle, rather small, and of no noteworthy features. (It appears particularly small when compared with the glenoid cavity, which, as I should have remarked before, is of unusual width.) Thus the mandibles, viewed from behind, present the curious appearance of three prongs—condyle, incisor-knob, and exterior process. The appearance of trifurcation is best marked in *Thomomys*, where the tooth-knob is most prominent, and separated by deepest notches from the processes between which it stands. In addition to all these prominences, a slender, falcate, acute coronoid rises in front, and overtops the rest, being separated from the condylar ramus by a deep notch. There is a deep excavation between the thin laminar basis of the coronoid and the molar alveolus. The foramen of the inferior maxillary nerve appears on the inner side of the root of the condylar ramus.

The dental formula has been already given. The molar dentition appears weak and slight in comparison with the enormous incisors. The under incisors, as already said in effect, run the whole length of the jaw, and push up a knob of bone behind. They are of the ordinary scalpriform construction, quite flat-faced, with converging sides, and beveled to an edge behind. The superior incisors describe nearly a semicircle through the intermaxillaries, and far into the maxillaries, to below the root of the zygoma. They are of distinct character in the two genera, furnishing the most ready means of diagnosis, not only of the genera, but of the species of *Geomys*, as already fully given in the body of this paper.

The molars are perennial rootless prisms, as in *Arvicolinæ* and many other hard gnawers, but are small and of a very simple structure—at least in comparison with the complicate character which obtains in many rodents. The whole molar series is scarcely one-seventh of the length of the skull. They are implanted very obliquely to suit the peculiar conformation of the parts. The axis of the anterior upper molar slopes backward at an angle of about 45°, and the rest succeed with regularly-diminishing obliquity. The relation is reversed in the lower jaw, where the back molar slopes forward, the rest becoming successively more nearly perpendicular. There is the same number of teeth in both jaws, and they are quite similar in construction. The anterior molar in each jaw is a double prism; the others are single and simple, elliptical in cross-section, the first being a pair of ellipses laid together like a short broad figure-of-eight, and the last approaching a cylindrical figure. The relation of the molars to each other is somewhat singular. Their roots are all widely diverging, but their crowns come into close contact. This is effected by the curve in their axis. Thus the front upper molar is curved with the convexity posterior; the rest are curved successively more and more, with the convexity anterior. Similar characters mark the under molars, though less strongly; and there is seen in these teeth, especially in the anterior ones, a lateral as well as fore-and-aft curve. This shape appears to be forced upon the teeth by the peculiar conformation of the alveoli. The molars are quite similar in the two genera, and scarcely afford diagnostic characters, especially since there is some change in the details of the molar crowns with age and wear of the teeth. On the whole, however, it may be observed that in *Geomys* the molars—the immediate ones, at any rate—are more perfectly elliptical than they are in *Thomomys*, where a pinching-together of the exterior portion of the ellipses tends to result in a pyriform contour.

The principal cranial and dental characters of the two genera which compose the *Geomyidæ* may be shortly contrasted, as follows:

GEOMYS.	THOMOMYS.
Superior incisors deeply channeled along the middle, with or without a fine marginal groove.	Superior incisors without median sulcus, but with a fine marginal groove (sometimes obsolete).
Crowns of intermediate molars truly elliptical.	Crowns of intermediate molars acute-edged exteriorly.
Root of inferior incisor but little protuberant on outside of base of condylar ramus; end of mandible thus only two-pronged, with a knob between.	Root of inferior incisors causing a protuberance on outside of base of condylar ramus nearly as high as condyle itself; end of mandible thus singularly three-pronged.
Zygomata widest across anteriorly, thence contracting; the width behind little, if any, greater than the intermastoid diameter of the skull.	Zygomata regularly convex outward, with a sweeping curve; their breadth across posteriorly decidedly greater than the intermastoid diameter of the skull.
Parietals ridged along their line of union with each other.	Parietals ridged externally near the squamo-parietal suture.
Interparietal triangular.	Interparietal rather pentagonal.
Nasals approximately parallel-edged part way, then suddenly widening.	Nasals widening uniformly from behind forward.
Superficies of mastoid bone occupying nearly half the occipital surface of the skull on each side.	Superficies of mastoid bone restricted to less than a fourth of the occipital surface on each side.
Bullæ osseæ less inflated, quite acute anteriorly.	Bullæ osseæ more inflated, quite obtuse anteriorly.
Basi-occipital, in the middle, about as broad as the width of the bulla at the same point.	Basi-occipital, in the middle, much narrower than the bulla at the same point.
A pair of broad deep pits on the palate behind, extending forward to opposite the penultimate molars.	A pair of slight pits on the palate behind, not extending beyond the ultimate molars.

Pterygoids ——? (will be found differing appreciably from those of *Thomomys*).	Pterygoids appearing like a bifurcation into two thin diverging plates of a single median vertical palatal plate.

In like manner, we may proceed to compare some of the principal cranial characters of *Geomyidæ* and *Saccomyidæ.* Notwithstanding the unquestionably close affinity of these two families, which must stand next to each other in the system, their crania are curiously different in general appearance and details of contour. The discrepancies are, however, of a superficial character, resulting mainly from the extraordinary molding of the parts in *Saccomyidæ.* In other words, it is a matter of mere *shape*, for the most part. There are, however, some curious and more essential features, of which the enormous inflation of various elements of the temporal bone and peculiar zygomatic relations posteriorly are the most remarkable. Probably, going into details, a hundred actual differences between the skulls of *Geomyidæ* and *Saccomyidæ* might be enumerated. I shall content myself with tabulating a few of the more important of these. The comparisons are made between *Geomys bursarius* and *Dipodomys ordi;* it should be remembered, however, that the latter presents an extreme case, the average characters of the *Saccomyidæ* being less different from those of *Geomyidæ.*

GEOMYIDÆ.	SACCOMYIDÆ.
Skull massive, angular, in general like that of *Arvicola*, &c.	Skull thin and papery, the corners rounded off; the resulting general shape peculiar.
Interorbital space the narrowest part of the skull—narrower than rostrum.	Interorbital space expanded, very much broader than the rostrum.
Occipital region approaching a plane surface, without median emargination.	Occipital region formed chiefly of enormous bulging mastoids, with deep median emargination.
Nasal bones not produced beyond	Nasal bones produced far beyond in-

vertical plane of incisors; rostrum broad, parallel-sided.	cisors; rostrum attenuated, tapering.
Parietals small, linear, remote from the orbits.	Parietals large right-angled triangles, together as broad as the frontal, reaching orbits.
Occipital of an ordinary character, not attaining top of skull.	Occipital reduced and of peculiar shape; a part of it mounting the top of the skull.
Temporal bone, though of great extent, not remarkably inflated.	Temporal bone unique in its enormous size and inflation, being blown up like a bladder; the swollen mastoids forming most of the occipital plane; the two temporals larger than all the rest of the skull together.[*]
Squamosal roofing most of the cerebral cavity.	Squamosal restricted to the orbit.
Zygomata of an ordinary character, with the usual connections.	Zygomata thread-like in most of their extent, and greatly depressed in position; *the malar bone abutting against* the tympanic.
Tympanic, a contracted tube.	Tympanic, an inflated vestibule.
Petrosals discrete from each other, in contact with basi-occipital.	Petrosals in mutual contact at their extremities, and fissured away from basi-occipital.
Mastoid excluded from roof of cerebral cavity.	Mastoid roofing most of cerebral cavity.
Zygomatic process of maxillary a plate with merely thickened upper border.	Zygomatic process developing into a shield over much of the orbital space.
Palatal outline strongly ascending	Palatal profile nearly straight and

---

[*] If the sense of hearing of *Dipodomys* be co-ordinated with the osseous development of the auditory apparatus, it must be extraordinarily acute.

and arched anteriorly; molars far below level of zygomata.	horizontal; molars on a level with the zygomata.
Incisors large, parallel-edged, scarcely converging.	Incisors small, acuminate, convergent.
Anterior molar, a double prism.	Anterior molar, a single prism.
Root of inferior incisor protuberant posteriorly.	Root of inferior incisor not prominent posteriorly.
Large erect falcate coronoid, overtopping condyle.	Minute prickle-like sloping coronoid, far below level of condyle.
&c., &c.	&c., &c.

ADDENDUM B.

NOTES ON THE "SALAMANDER" OF FLORIDA (GEOMYS TUZA).

[*Communicated to the author by Prof. G. Brown Goode.*]

One of the most interesting mammals of the Southern Atlantic States is the species of *Geomys* known in Florida and Georgia as the "Salamander." The name of "gopher," by which the various representatives of this genus inhabiting the Upper Mississippi Valley are known, would seem very appropriate for this animal. It appears to be a corruption of the French "gaufre", and to refer to the manner in which the soil is honey-combed by the pouched rats.

Local usage, however, has appropriated this name to a kind of land-tortoise, *Xerobates carolinus*, (Linné) Ag., which is common in Georgia and Florida, and which also excavates a burrow, a habit to which, perhaps, it owes its name. I have never heard an explanation of the name "salamander" in its application to *Geomys tuza;* but it occurs to me that it may allude to the safety enjoyed by these little animals in their subterranean abodes at the time of the devastating fires which sometimes consume the pine-forests. After such a conflagration has passed over their heads, destroying every other kind of life, they are seen at work among the ashes, very good types of the salamander of fable, which passes unharmed over burning coals, and

> "with her touch
> Quenches the fire, though blazing ne'er so much."

Although the species was not scientifically described until 1817, it was noticed by several among the earlier writers. William Bartram, an English naturalist, who visited the Southeastern States in 1773, speaks of a large ground-rat, which he observed in the vicinity of Savannah, which was more than twice the size of the common Norway rat, and which in the night threw out earth, forming little mounds or hillocks.[*]

---

[*] Travels through North and South Carolina, Georgia, East and West Florida, the Cherokee Country, the extensive territories of the Muscogulges or Creek Confederacy, and the country of the Chactaws. * * * —By William Bartram.—Dublin.—1793. p. 7. [Orig. ed. Philadelphia, 1791.]

A brief description of the species, under the name of the Hamster of Georgia, was published in the New York Medical Repository in 1802, and afterward in an appendix to the American edition of Bewick's Quadrupeds. On this description was founded the name *Mus tuza*, cited in the list of American mammals published by Ord in 1815,* a name which antedates that of Rafinesque by about two years, and which has been adopted by Dr. Coues.

Notwithstanding their great abundance, it is extremely difficult to obtain specimens of the salamanders. Their acute sense of smell gives them an early warning of the approach of danger, and they easily make their escape in the maze of tunnels. Should one even be driven into a blind passage, it would find little difficulty in baffling its pursuer, for it can burrow faster than a man can follow with a spade; and, since it obliterates its track by throwing the soil behind, it leaves scarcely more trace of its passage in the loose sand than a fish swimming through the water. It is thought quite impossible to dig them out. Occasionally, they are shot, when they come to the surface to throw out sand; but they remain in sight only an instant, and the marksman, to be successful, must have his gun bearing upon the opening at which the animal is expected to appear, with finger on the trigger, and be ready to pull the moment the head is sighted.

By the patient use of steel-traps, while in Florida this spring, I obtained a number of specimens, some of which I succeeded in keeping for several weeks, thus having an excellent opportunity of studying their habits.† They may easily be confined in a wooden box, with sides eight or ten inches high, having dry sand two or three inches deep on the bottom. No cover is necessary; I have never seen one look up from the earth, and have rarely known them to attempt to escape. They require no water, and no food except sweet-potatoes. A single potato of moderate size will feed a salamander for three days.

The senses of sight and hearing seem in them to be very dull. An object may be held within a short distance of their eyes without attracting their attention; but the moment one is touched, he turns with a jump, snapping fiercely, much to the detriment of fingers which may be near. If two are confined in the same cage, the one does not seem aware of the presence of the other, unless they accidentally come in contact. Their eyes are small, dull, and without expression. Their sense of smell I judge to be very delicate, from the manner in which they approach the hills of potatoes. Their motions are surprisingly quick and energetic; their activity never ceasing from morning to night.

---

* Guthrie's Geography, 2d American edition, ii, 1815, p. 292.

† Two of them, which I sent to the Zoological Society of Philadelphia, may be seen in the garden at Fairmount Park.

They are very pugnacious, and a rough-and-tumble combat between two vigorous males would seem terrific, if their size could be magnified a few diameters in the eye of the spectator. Every muscle of their compact, elastic, stout bodies is brought into action, and they plunge and bite with wonderful ferocity. A battle is usually followed by the death of one or both. I have examined them after death, and found the whole anterior part of the body bruised almost to the consistency of paste, the bones of the legs crushed in four or five places. When two come together in the cage, their salutation is a plunge and a bite.

I watched their burrowing with much interest. They dig by grubbing with the nose and a rapid shoveling with the long, curved fore paws, assisted by the pushing of the hind feet, which remove the dirt from beneath the body and propel it back with great power a distance of eight or ten inches. When a small quantity of earth has accumulated in the rear of the miner, around he whirls, with a vigorous flirt of the tail, and joining fore paws before his nose, he transmutes himself into a sort of wheelbarrow, pushing the dirt before him to a convenient distance, and repeating the act until the accumulation is removed, then resuming his mining. Any root or twig which blocks his way is quickly divided by his sharp chisel-teeth. I have never seen a salamander place sand in his cheek-pouches, though I have watched their burrowing hour after hour. . It is, of course, impossible to observe them when at work under ground, but I incline to believe that most of the refuse earth from the burrows is transported in the manner just described. The negroes told me that they had seen the salamander appear at the mouth of its hole for an instant and "spit out" the sand which it carried in its pouches, aiding the act by inserting the fore paws *into* the pockets. I have never met any one who could tell *exactly* what the salamander does at the instant he appeared, his motions being so quick that one cannot be quite sure; the general impression, however, is, that they are unloading their cheek-pouches. This is not at all improbable, for we know that they carry their food in these receptacles, and it seems a very natural way for them to bring their refuse sand to the surface, since they often have to transport it a distance of several feet. Still it is quite desirable to have other and more careful observations; for observers are apt to be deceived by their own eyes, especially in the light of preconceived opinions.

The subterranean labyrinth constructed by this clever army of sappers and miners penetrates the pine-barrens and cultivated fields in every direction. An energetic salamander, with a slight knowledge of engineering, would find little difficulty, I suspect, in making an underground journey through Florida from the Atlantic to the Gulf of Mexico. The direction of the burrows may easily be traced by the loose hillocks of white sand which are thrown up along the line at intervals of three or four feet. These are the "dumps" made by the burrower in throwing out his refuse accumulations. Each consists of about a peck of loose sand, and, by the casual observer, might easily be mistaken for an ant-hill. No opening is visible, but by digging under the hill a hole is found, the mouth of the adit to the main tunnel, which may be three feet below the surface if made in cold weather, but perhaps not more than six inches if in summer. One of these mounds is thrown up in a very few moments; I have seen thirty raised in a single night on the line of one tunnel; this would represent nearly one hundred feet of tunneling. I have seen one hundred and fifty in one continuous row raised in about two days; this would make between four and five hundred feet of burrow completed in that short time apparently by one little animal, an amount of work which may seem incredible to one who has not watched the restless movements of these animated plows, which are seemingly as well adapted for piercing the sand as birds are for cleaving the air. The burrows are about two and one-half inches in diameter, barely large enough to admit a man's hand, and, as has been stated, are at various depths below the surface. They meander in all directions, except in straight lines; their builders being guided apparently only by their whims or their olfactories. They, no doubt, intersect each other at many

INDEX.

Page.
Alcoves 176
Alcove land, The 151
—— lands, defined 149
—— lands of White River 167
Ancient lands 212
Antecedent valleys defined 163
Antiquity of arid conditions 209
Aquarius Plateau 137
Arable land, Distribution of 143
Arid conditions, Antiquity of 209
Ascomys 220
—— borealis 250
—— bulbivorus 258
—— bursarius 251
—— canadensis 221
—— douglasii 259
—— mexicanus 236
—— rufescens 251
—— talpoides 250
—— townsendii 251
—— umbrinus 261
Ashley 17, 26
—— Falls 17
Bad-lands described 149, 151
—— north of the Uinta Mountains 10, 150
—— south of the Uinta Mountains 166
—— of erosion 171, 203, 206, 209
Berthoud, Captain 41
Bitter Creek 151
Black's Fork of the Green 10
Boats, Description of 8
Book Cliffs 53, 167, 170, 172, 174
Bow-Knot Bend 53
Brown Cliffs 53, 167, 170, 172, 174
Brown's Park 19, 157, 161
Bright Angel River 86
Buttes, Origin of 173
Camas rat 221
Canada rat 221
Canadian hamster 221
Cañon, Cataract 60, 175
——, Desolation 46, 168, 170, 174
——, Glen 68, 177

Page.
Cañon, Grand 80
——, Gray 50, 167, 170
——, Gypsum 65
——, Horseshoe 14
——, Kanab 197
——, Kingfisher 14
——, Labyrinth 52, 167, 170, 174
——, Lodore 22, 161
——, Marble 73, 180
——, Mu-koon'-tu-weap 111
——, Narrow 68, 175
——, Pa-ru'-nu-weap 5, 109
——, Red 16, 157, 161
——, Split Mountain 38, 157, 161
——, Stillwater 54, 175
——, Swallow 19
——, Whirlpool 35, 161
Cañons due to erosion 197
——, lateral to the Grand 197
—— of the Colorado, Exploration of 1
—— of the Colorado, Myths of 7
——, The Terrace 167
Carboniferous at the Grand Wash 187
—— at the Paria Fold 178
—— in the Grand Cañon 190
—— in the Kanab Cañon 197
—— on the Kaibab Plateau 212
—— strata 177, 180
Cataract Cañon 60, 175
Caves 58
Chestnut-faced gopher 230
Cliff erosion 205
—— of the Harp 23
Cliffs 6
——, Book 53, 167, 170, 172, 174
——, Brown 53, 167, 170, 172, 174
——, Echo 73, 189, 191
——, Orange 55, 167, 170, 172, 176
——, Pink 107, 135, 190
——, Shin-ar'-ump 190
——, To-ro'weap 188
——, Vermilion 112, 134, 180, 190, 200
——, White 134

Page.
Cliffs and slopes of displacement.......... 182
—— characteristic of a dry climate....... 171
——, Formation of........................ 204
——, Measurement of, by the eye.......... 16
—— of erosion............................ 190
—— of erosion thrown forward by displacements................................. 191
Climbing out of the cañon.... 64
Coauini Creek........................... 197
—— Plateau............................... 194
Colorado Chiquito River 77, 180, 197
—— River................................. 60
—— ——, Sources of the.................. 3
—— ——, Tributaries of the.............. 4
Consequent valleys, defined 163
Corrasion................................ 179
Coues, Dr. Elliott, on Geomys and Thomomys.................................... 216
Cranial characters of Geomyidæ.......... 267
Cretaceous in Gray Cañon................. 170
—— strata 190
Cricetus................................. 220
—— bursarius............................. 221
—— talpoides............................. 250
Crossing of the Fathers.................. 72
Dawes, Mount............................. 34
Dental characters of Geomyidæ........... 267
Descent into the Grand Cañon............ 122
Desolation, Cañon of...............46, 168, 170, 174
Diamond Creek........................... 196, 199
Dike 81
Diplostoma............................... 220
—— alba.................................. 221
—— bulbivorum 258
—— fusca 221
Diplostome blanche....................... 221
—— brun.................................. 221
Dirty Devil River 67, 107, 133, 138, 141, 176
Disaster Falls........................... 26
Distances and heights...12, 21, 30, 43, 56, 79, 145, 180
Displacement, Cliffs and slopes of.......... 182
——, influence on cliffs of erosion......... 191
Distribution of forest.................... 142
—— of water, arable land, grass, &c...... 143
Drift of the valley of the Mississippi 208
Eastern Kaibab fault 186, 192
Echo Cliffs 191
—— Park 32
Eclipse of the sun 74
El Vado de los Padres.................... 72
Emma, Mount 200
Erosion, Ancient 213
——, Base level of 171, 203, 206, 209
—— by streams, Manner of 179
——, Cliffs of 190

Page.
Erosion in the Colorado region relatively small..................................... 209
——, Magnitude and results of............. 208
——, Methods and conditions of............ 202
Eruption as an agent in topography....... 206
Eruptive mountains carved from sedimentary beds................................ 177
Escalante, Father........................ 72, 138
—— River................................. 138
——, Sierra 35
Exploration of the valley of the Colorado. 1
Falls, Ashley............................. 17
——, Disaster 26
——, Triplet 27
Fault, Eastern Kaibab.................... 186, 192
——, Grand Wash........................... 186
——, Hurricane Ledge...................... 186, 199
——, To-ro′-weap.....................186, 196, 199
——, Western Kaibab 186, 192
Faults discussed 182
—— in Uinta Mountains.................... 156
Fire in camp............................. 29
Flaming Gorge 11, 14, 157, 161
Floods, Sudden........................... 65, 86
Fold at the Toom′-pin Wu-near′ Tu-weap′.. 175
—— near the San Juan River 178
——, Paria 178, 185
——, Uinta 152, 159, 162
Folds, Minor, of the Uinta Mountains...... 58
——, Monoclinal, discussed................ 182
Forest, Distribution of.................. 142
Gaufre 221
Geomys 220
—— borealis 250
—— breviceps............................. 221
—— bulbivorus............................ 258
—— bursarius 221
—— canadensis............................ 221
—— castanops............................. 233
—— clarkii 233
—— des pins 230
—— douglasi 259
—— drummondii 221
—— fuliginosus 259
—— fulvus................................ 261
—— hispidus.............................. 239
—— mexicanus............................. 236
—— oregonensis........................... 231
—— pineti 330
—— pinetis 230
—— rufescens 251
—— talpoides 251
—— townsendii............................ 251
—— tuza.................................. 230
—— umbrinus.............................. 261

Page.
Geomys unisulcatus 261
Gilbert, G. K., on antiquity of arid conditions 211
Glacial epoch 211
Glen Cañon 68, 177
Goblin City 41, 167
Goffer 221
Goode, Prof. G. Brown, on Geomys tuza 279
Gopher 221, 230
Grand Cañon 80
—— ——, Descent into the 122
—— —— described 193
—— ——, Region traversed by the 185
Grand River 56
—— ——, Sources of the 3
Grand Wash 102, 187, 188
—— —— Fault 186
Granite 81, 96, 193, 212
Gravels of the Great Salt Lake Desert 211
—— on the flanks of the Uinta Mountains 207
Gray Cañon 50, 167, 170
Great Salt Lake Desert, The 211
Green River City 151
Green River older than the Uinta Fold 152, 162
—— ——, Sources of the 3
Gunnison's Crossing 51
Gypsum Cañon 65
Hamblin, Jacob 107, 128, 133, 137
Hamster du Canada 221
Hamster of Georgia 230
Harp, Cliff of the 23
Hawkins, Mount 38
Heights and distances 12, 21, 30, 43, 56, 79, 83, 180
Hell's Half-Mile 28
Henry Mountains 71, 137, 141, 177
Henry's Fork of the Green 11, 12
Hill and mountain erosion 205
Hog-back erosion 205
Hog-backs 159
——, Formation of 204
Horseshoe Cañon 14
House Rock Valley 192
Howland brothers and Dunn determine to leave the river 98
—— —— —— ——, Murder of 130
Hughes, General 41, 167
Hurricane Ledge 187
—— —— Fault 186, 199
Indian garden 96
—— rafts 51
Indians 17, 42, 104, 113, 140
——, Kai-vav-its 107, 189
——, Navajo 72, 189
——, Shi'-wits 115, 128, 189
——, Food of 126
Inscription at Ashley Falls 17

Page.
Island Park 38
Ives, Lieut. J. C 195, 196, 199
Junction of the Grand and Green Rivers 56
Jurassic at foot of Gray Cañon 170
—— strata 190
Kaibab Plateau 185, 188, 192, 194, 212
Kai-par'-o-wits Plateau 137
Kai-vav-its 107, 189
Kanab 132, 133
—— Cañon 197
—— Creek 106, 197
Kingfisher Cañon 14
Labyrinth Cañon 52, 167, 170, 174
Lavas, Ancient 213
Lava streams 94
—— ——, Recent 131
Legend of the So'-kus Wai'-un-ats 116
Lodore, Cañon of 22, 161
Logan, Mount 200
Marble Cañon 73, 180
Marvine, A. R., on the valley system of the Rocky Mountains of Colorado 164
Mauvaises terres 149
Measurement of cliffs by the eye 16
Mesquite 77
Minor folds of the Uinta Mountains 158
Monoclinal folds discussed 182
Mountaineers 12
Mountain sheep 66
——, Navajo 136
——, San Francisco 197
Mountains, Abajo 175
——, Escalante 35
——, Henry 71, 137, 141, 177
——, La Sal 56, 175
——, Trumbull 131, 200
——, U-in-ka-ret 131, 189, 199, 200
——, Uinta 10, 152, 200, 206
——, Volcanic 6, 58, 131
Mount Dawes 34
—— Emma 200
—— Hawkins 38
—— Logan 200
Mu-koon'-tu-weap Cañon 111
Mus 220
—— bursarius 221
—— ludovicianus 221
—— saccatus 221
—— tuza 221
Music Temple 70, 178
Myths of the cañons of the Colorado 7
Narrow Cañon 68, 175
Navajo Indians 72, 189
—— Mountain 136
Non-conformable beds under Kaibab Plateau 212

Page.
Newberry, Dr. J. S 196
— — — —, on the erosion of the cañons 198
Orange Cliffs 55, 167, 170, 172, 176
Oryctomys 243
—— bottæ 258
Paria Fold 178, 185
—— Plateau 192
—— River 73, 106, 133, 135, 197
Pa-ru′-nu-weap Cañon 5, 109
Party Names of 9, 134
——, Separation of 99
Pauns-a′-gunt Plateau 107, 135
Peat bog 107
Pecos gopher 233
Physical features of the valley of the Colorado 148
Pink Cliffs 107, 135, 190
Pipe Spring 112, 132
Plateau, Aquarius 137
——, Coanini 194
——, Kaibab 185, 188, 192, 194, 212
——, Kai-par′-o-wits 137
——, Paria 192
——, Pauns-a′-gunt 107, 135
——, San Francisco 186, 195
——, Shi′-wits 187, 189
——, Table Cliff 139
——, Yampa 159
Plateaus 193
Pleasant Creek 140
Pocket gopher 221
Poisoned by potato-tops 45
Potato Valley 136
Pot-holes in Echo Cliffs 189
Pouched rat 221
Pseudostoma 220
—— borealis 250
—— bulbivorum 258
—— bursarius 221
—— castanops 233
—— douglasii 259
—— fulvus 261
—— floridana 230
—— hispidum 239
—— mexicana 236
—— talpoides 250
—— umbrinus 261
Pseudostome à bourse 221
Rapids, Manner of passing 22, 23, 50, 83
——, relation to dip and texture of strata 73, 81
——, Waves of, distinguished from wind-waves 22
Red Cañon 16, 157, 161
River, Black's Fork of the Green 10

Page.
River, Bright Angel 86
——, Colorado 3, 4, 60
——, Colorado Chiquito 77, 180, 197
——, Dirty Devil 67, 107, 133, 138, 141, 176
——, Escalante 138
——, Grand 3, 56
——, Green 3
——, Henry's Fork of the Green 11, 12
——, Paria 73, 106, 133, 135, 180, 197
——, San Juan 73, 178
——, Sevier 106
——, Uinta 41
——, Virgen 41, 104, 106, 109, 197
——, White 5, 30, 32, 41
——, Yampa 5, 30, 32, 41
Rock Rovers Land 112
Rocky Mountains of Colorado, Inter-hog-back valleys of 163
——, Superimposed valleys of 163
Ruins, Shi′-ni-mo 69, 77, 87, 90, 125
Saccomyidæ, cranial characters of 276
Saccophorus 220
—— albus 221
—— borealis 250
—— bottæ 258
—— bursarius 221
—— mexicanus 236
—— pineti 230
—— quachil 239
—— talpoides 250
Salamander 221, 230
Sand-rat 221
Sandstone 50
San Francisco Plateau 186, 195
—— Mountain 197
San Juan River 73, 178
Shin-ar′-ump Cliffs 190
Shi -wits Indians 115, 128, 189
Plateau 187, 189
Shipwreck of the "No Name" 24
Showers causing sudden floods 65, 76, 86
Sierra Abajo 175
—— Escalante 35
—— La Sal 56, 175
So-kus Wai′-un-ats, Legend of the 116
Split Mountain Cañon 38, 157, 161
Standing rocks 176
Stillwater Cañon 54, 175
Superimposed valleys defined 166
Swallow Cañon 19
Table Cliff Plateau 136
Taschenmaus 221
Temples of the Virgen 111
Terrace Cañons, The 167
Terraces 6

Page.
Tertiary in the Cañon of Desolation 170
—— in the Pink Cliffs 190
Thomomys 243
—— borealis 250
—— bottæ 259
—— bulbivorus 249, 258
—— clusius 250, 263
—— douglassii 592
—— fulvus 251, 261
—— laticeps 259
—— rufescens 251
—— talpoides 249, 250
Thompson, A. H., Report of 133
Thousand Wells, The 189
Toom'-pin Wu-near' Tu-weap' 54, 58, 174, 175
To-ro'-weap Cliffs 188
—— Fault 186, 196, 199
—— Valley 186
Tower Park 54
Trias in Glen Cañon 177
—— in the Vermilion Cliffs 190
Triplet Falls 27
Trumbull, Mount 131, 200
Tuça 236
Tucan 236
Tugan 236
Tusayan, Province of 87
Tuza 236
U-in-ka-ret Mountains 131, 189
—— —— described 199
—— ——, Geological history of 200
Uinta Fold, relation to drainage system 159
—— —— younger than the Green River 152, 162
—— Mountains 10, 152, 200, 206
—— ——, Cañons of the 13, 157

Page.
Uinta Fold, Course of the Green River through the 18
—— —— geology of the 152
—— ——, portion east of the Green River 20, 35
—— ——, their base-level of erosion 206
—— River 41
Valley, House Rock 192
——, Potato 136
——, To-ro'-weap 186
——, Won'-sits 44
Valleys, Antecedent, defined 163
—— classified 160
——, Consequent, defined 163
——, Inter-hog-back 159, 162
—— of the Uinta Mountains, classified 161
——, Superimposed, defined 166
Vasey's Paradise 76
Vermilion Cliffs 112, 134, 180, 190, 200
—— Creek 20
Virgen River 41, 104, 106, 109, 197
Volcanic cones 94, 114, 196, 202
—— mountains 6, 58, 117, 131, 177, 200, 206
Volcano, Extinct, on Shi'-wits Plateau 187
Water-shed of Southern Utah 106
Waves produced by rapids and by winds 23
Western Kaibab fault 186, 196
Whipple, Lieutenant 199
Whirlpool Cañon 35, 161
White Cliffs 134
—— River 5, 30, 32, 41
Won'-sits Valley 44
Yampa Plateau 159
—— River 5, 30, 32
Zoology 214

○